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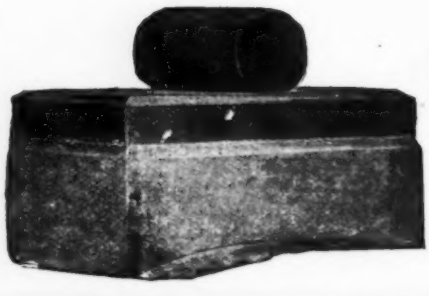

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Costs and Selling Prices.

THE selling price of any commodity, if profits are to ensue, must lie between the cost of production on the one hand and the figure which will cause the consumer to make use of a substitute or to go without. While the acquisition of profits ought not to be the only object of life, it is impossible to continue to carry on business unless profits result. The economist considers the value of an article to be dependent upon the labour required to produce it. In fact, it has been stated that if two things require the same labour to produce them, they are exactly equal in value. Ruskin attacked this view in bitter terms, and defined "the exchangeable value of a commodity" as "that of the labour required to produce it, multiplied into the force of the demand for it." If, in what follows, we speak of "cost" and of "demand value" as the limits between which a profitable selling price must lie, we think our meaning will be tolerably clear.

But, although our meaning may be clear, ideas are very often the reverse of clear as to what the cost of an article really is. The cost of raw material can be ascertained, and the amount of time occupied at a given rate per hour can be checked, but the distribution of factory overhead charges is, in far too many cases, thoroughly unsatisfactory. In electrical factories the methods of allocation are, in general, two: The first is the addition of a certain percentage of the labour cost, and the second is the machine-rate method. In dealing with Mr. G. H. Nelson's paper on "Works Production," read before the Institution of Electrical Engineers on January 18th, 1923,* we noted that it had been the experience of at least one large manufacturing company that the machine-rate system gave results that

*ELECTRICAL REVIEW, February 2nd, 1923, Vol. XCII, pp. 161-2.

were both more accurate and more readily available for the guidance of the management. The labour cost method is both crude and inaccurate, because an article made by a highly-paid man, although it may be almost entirely made by hand, and not involve any use of costly machinery, gets loaded with a kind of compound interest of overhead charges. On the other hand, one made by cheap labour on a machine will be but lightly loaded, though it is clear that a skilled man will be able to supervise himself, while boys or women will require constant supervision, which is an expensive matter.

Some may object that, provided the whole of the known overhead cost of the factory gets distributed over the whole of the product, the final balance-sheet will show the same amount of profit, whatever method of allocation be adopted. So it will, but although the total cost of the whole product be accurate, every single item in it may be entirely wrong. Some may be let off too lightly, thus showing abnormally high profits; others will carry too much overhead cost, and so appear to be produced at a loss. The incidence of the on-cost allocation is a matter of vital importance, as it affects the fixing of the selling price. Many of our readers must have experience of such statements as "the such-and-such department is being carried on at a heavy loss," and "we cannot afford to sell so-and-so at the price buyers are willing to give"; often coupled with "the something-else is the most profitable line we have." The principle of ability to pay, or of charging what the traffic will bear, should come in here, and when it does come in, the aspect of things is often completely changed. If the whole of the overhead charges have been provided by the profits on a few lines, or by the whole product in a portion only of the financial year, then other work taken on at anything above the cost of labour and material will have the effect of increasing the profits, although the amount of on-cost borne be but trifling. We want to press this point home, as it is within our personal knowledge that it is far from being generally known, or properly appreciated, even by those having the direction of affairs in important undertakings. This school of thought acts on the lines that if the shops are sufficiently full of work to make it certain that there will be a profit, *increase* the selling price, so that any additional orders accepted will be still more profitable, and dividends will be greater. Dividends, as we said at the beginning of this article, are both desirable and necessary, but such a policy as this—and it is far from uncommon—is opposed to the idea of service, which is even more desirable and more necessary, and which leads, in the ultimate result, to greater financial strength. We instanced in a recent article the application of this principle to the fixing of prices for export business, but this is not by any means the only direction in which it can, and ought to, be used. A striking parallel can be drawn between this mercantile problem and that of the supply of electricity. We venture to think that if any electricity undertaking endeavoured to sell all the energy generated at total cost, plus a percentage for profit, it would head straight for bankruptcy. Lighting energy would be sold at an unnecessarily low price, while power, heating, and domestic energy would be offered at such a high price that nobody could afford to use electricity for these purposes. It is by the system of allocating the greater part of the capital charges to the primary object of lighting that the load which fills up the hollows of the curve can be taken on at a price which is acceptable to both supplier and consumer. The parallel goes further, for the profits on the cheap energy can eventually be used to reduce the selling price of the more expensive, thus increasing business in every direction.

A proper system of costing is essential to the proper carrying on of business. As a check on waste and extravagance it may well pay for itself, but as a means of directing future policy it is invaluable.

American Electrical Exports and their Destinations.

A HIGHLY interesting review of last year's export trade in American electrical machinery and apparatus is contained in the official *Commerce Reports*, published by the United States Bureau of Foreign and Domestic Commerce. The Bureau ascribes the growth which has taken place in these exports to the real merchandising efforts made by the increasing number of electrical manufacturers. A profitable year, it is said, has been experienced by those organisations which have studied the promising fields for activity for their particular product, which have arranged for adequate representation, which have kept in close touch with agents and given real "service," and which, furthermore, have acquired a good idea of what an agent might be expected to do through their close analysis of trade statistics. This last point is worth emphasis, for there is a tendency to belittle the importance of the statistical records of the consumption of goods in oversea markets. It is true that sometimes these are belated, yet they generally furnish a useful indication of the trend of sales.

Although the figures for the full twelve months of 1923 are not yet known, it is estimated that the total exports from the United States of all classes of electrical goods during the year approximate $70,000,000, or about $7,000,000 more than the total for 1922.

Exports of generating equipment were somewhat larger, and a net gain was shown in motors, with noteworthy increases in fractional horse-power and small motors. There was also a good increase recorded in the shipments of motor-control equipment, a considerable portion of which undoubtedly was railway control equipment.

Transformer exports decreased considerably during the year, the shipments during the first 10 months of 1923 being only $2,413,562 as compared with $3,596,574 during the same period of 1922. Electric locomotives, however, show a good gain over the preceding year as a result of several large electrification contracts secured by American manufacturers during 1922.

In the branches connected with wireless telephony, noteworthy increases are shown, the total being rather over $3,000,000, as compared with $2,380,000 during 1922. American manufacturers, assisted by the experience gained in catering for the large demand in the States for domestic labour-saving and other electrical appliances, are continuing their success in export markets. Their shipments of motor-driven household devices, of domestic heating and cooking appliances, showed a considerable advance on the year.

It is noted that sales abroad of incandescent lamps were slightly lower than during 1922, due, no doubt, to the growth of various local factories in markets which have previously relied mainly upon imports. On the other hand, wiring materials, lighting fixtures and accessories increased remarkably, the total for the ten months being over $900,000, as compared with $360,000 during the same period of 1922. Similarly, copper wire and cable showed a marked increase.

In its review, the Bureau also surveys the various markets for the different lines of goods, and some useful indications may be gained from the details given.

North American markets took the largest percentage of United States electrical exports, with Canada naturally the most important of these, though there was improvement in both Cuba and Mexico. Radio exports were an important factor in United States trade with Cuba, the broadcasting stations established there having resulted in a heavy sale of that class of electrical goods. There was nevertheless a well-balanced demand for all electrical items from that market. The more settled conditions in Mexico naturally brought about an improvement in United States exports to that country, and while the volume of business during the year was in lighting equipment and supplies rather than in power apparatus, there was a uniform increase shown in practically all classes of electrical goods.

United States electrical exports to South America showed a considerable gain over those of 1922, with Argentina, Brazil, and Chile, as usual, the leading

markets. In Argentina, as in Cuba, radio was a heavy item, and United States general exports to that country were more important in communication equipment than in power apparatus lines.

A large proportion of American electrical exports to Japan consisted of large generators, transformers, switchgear, switchboard equipment and lightning arresters, due to the activity shown by Japan in the development of its water power resources. An appreciable volume of exports of motors ranging from one to 200 horse-power, and insulated wire and cable, is significant as showing that business is being done in those lines in Japan despite the fact that a great deal of such apparatus and material is made locally. Japan in the past was reputed to be a country of cheap labour. Since the beginning of the late war the cost of living has, it is known, been growing rapidly, and it is therefore instructive to find that United States manufacturers have been selling increasing quantities of household electrical appliances and heating devices such as are in favour where servants are scarce or expensive.

With regard to the European market, Great Britain was the most important customer of the United States for electrical goods, the major part of the business being in household appliances, lighting equipment, batteries and supply lines, together with a fair amount of insulated copper wire and cable, and a large number of fractional horse-power motors.

The increased business in France was largely in power equipment and materials, the demand for which has been accentuated by the interest in power transmission development, and to some extent railway electrification. Among the exports to Spain, railway locomotives were a very important item, though there was a considerable volume of business done in insulated wire, railway signals, transformers, batteries, and lighting sets.

Australia continued as the important market in that part of the world, though the purchases hardly reached the volume of 1922.

Electric Passenger Lifts.

By reading a paper on Electric Lifts, full of novel and interesting information, before the Institution of Electrical Engineers, Mr. H. Marryat has done valuable service to the electrical industry; as he remarked, during recent years the literature of the subject has been most meagre, though a good deal was published in our columns before the war, and the only text-book that has been issued is the one that we reviewed some months ago. Mr. Marryat holds that we have followed American practice "so far as we have been able"; but that is not very far, the conditions being so very different in the two countries.

In some office buildings, stores, &c., in London the electric lifts are well managed and are almost constantly in motion, as they should be; but in many buildings—especially the quieter office blocks—they are not taken seriously, the attendants appearing almost to resent the intrusion of a passenger. We mention this not as being relevant to the subject of the paper, but as being indicative of the mental attitude of the community with regard to this matter. The lift, in fact, is often looked upon as supplementary to the staircase, whereas (as Mr. Marryat pointed out) the contrary should be the case. We hope that this paper will place the matter in the proper perspective.

One aspect of the paper is noteworthy in view of the joint meeting of architects and electrical engineers at the I.E.E. last year—the author draws attention in several passages to the aloofness of the architect, who does not possess the necessary technical knowledge to make proper provision for the installation of the most suitable type of elevator, and does not seek the advice of experts in this work, with the result that the lift maker has to make the best of a bad job and the customer is saddled with permanently increased maintenance costs. Similar complaints were advanced at the meeting above mentioned in respect of electrical installations for lighting and power; the architect is not familiar with the applications of electricity to domestic and industrial purposes, and consequently fails to take advantage of its manifold amenities, with the result that his clients are obliged either to dispense with them or to incur heavy and unnecessary outlay to make good the omission as far as is practicable. The architect, we fear, is prone to look upon his functions rather as those of an artist than as those of a designer of buildings equipped with the most up-to-date appliances for the comfort and convenience of the occupants.

London Electricity Tariffs.

London municipal authorities are growing restive under the high prices charged for electricity by company undertakers. Not long ago the Camberwell Borough Council took steps to bring to the notice of the Electricity Commissioners the charges for energy imposed by the County of London Co. (whose domestic tariff of 8d. for lighting and 2.4d. for heating and cooking has been the subject of several letters in our "Correspondence" columns), and now the City Corporation has resolved to petition the Commissioners to review the tariff of the Charing Cross Co., pointing out that when the latter was allowed to enter the City the maximum charge was 5d. per kWh. Leave was given to the company in 1920 to increase the maximum price to 8d., which at that time, we think, was not unreasonable; but it certainly was not intended that the maximum price should continue to be charged when the conditions improved, and it was remarked at the meeting of the Corporation that the company was paying largely increased dividends and bonuses to its shareholders, at the expense of those who used electricity.

There is no doubt at all that many companies, not only in the metropolis, have taken advantage of the fall in cost of production of energy to reap a golden harvest by maintaining the high charges permitted under most exceptional conditions; and those who, like ourselves, have in the past advocated private enterprise as being economically sounder than municipal trading are finding their position untenable in view of the striking contrast between the charges made by some companies and those made by some municipalities. When electrical energy for lighting, as well as for heating and cooking, can be obtained over large areas in London which are served by municipalities at prices less than half those mentioned above, it is more than difficult to justify the charges made by big companies. Moreover, such cases as that of Luton, where pre-war prices are in force, including a "point-five" tariff, must prove hard nuts for the advocates of super-power stations to crack. Even Manchester Corporation, which has plant of 209,000-kW capacity, cannot approach the Luton tariff. What is the "catch?"

The Field for Research on Illumination.

It has sometimes been doubted whether research can be "organised," and it is true that there will always be a field for spontaneous individual effort. At the same time, there are many forms of research that cannot be left to individuals, but require joint effort by experts of various kinds.

In his paper before the Illuminating Engineering Society on January 22nd, Mr. J. S. Dow pointed out that a decision as to the best methods of lighting for various processes should be reached, not merely by a consideration of available lamps and fittings, but also by going to the root of the matter—the impression received by the human eye. Hence the aid of the physiologist and the ophthalmic surgeon is essential. Similarly, when deciding the lighting requirements of various industries, persons representing those industries and conversant with the details of the operations to be illuminated must be taken into confidence. Progress on these lines may be slow, but it will be sure. Illumination has long ceased to be a purely "engineering" matter, and the policy of the Illuminating Engineering Society in inviting joint effort—"co-ordination of research"—is one that deserves to be widely followed.

Condenser Performance.

By JOHN BRUCE, A.M.I.E.E.

POWER station economical operation can be influenced to a very great extent by condensing-plant performance. The following article contains a brief description of simple and easily applicable methods for checking the condenser performance of a generating set in a few moments, and further, it describes a system whereby a continuous tabulated and graphical record of such performance can be recorded from day to day, and so show the behaviour of the plant at a glance. The methods described are those that are in use at the Dalmarnock generating station of the Glasgow Corporation Electricity Department, and should prove of interest to engineers engaged on the generating side of the industry.

Power station plant for the generation and utilisation of steam can only be intelligently and efficiently operated if provided with the necessary modern scientific instruments for indicating or recording that the correct combination of conditions is being maintained. This is a point now well enough recognised, at least by the larger undertakings, to need no elaboration here. It is, however, in this matter of instruments that the condensing plant is apt to be overlooked, and too often one finds that the only instrument provided for the indication of condenser conditions is one mercury U-tube connected to a point in the neighbourhood of the exhaust flange of the turbine or entry to the condenser. In many cases even an accurate instrument of the type mentioned is considered unnecessary, and the operating staff are expected to maintain efficient condenser operation from the indications of a diaphragm gauge of the Bourdon type. In such cases the operating engineer has no means of readily determining the value of partial air pressure, the state of the condenser as regards tube surface cleanliness, or when the correct terminal conditions for the unit have been obtained.

The steam consumption of a generating unit can be very greatly affected by variations in the initial and final conditions of the steam, and unless the unit is operated at the specified conditions for a particular load, or at the conditions which have in practice been found to give the best results, inefficiencies are bound to occur which will adversely reflect on the coal consumption of the station. The initial conditions of pressure and temperature are usually constant for all the sets in one station, and as the instruments for indicating these conditions are, as a rule, readily observable, variations can be readily detected and corrected. On the other hand, the absolute pressure carried in the condenser, condensate and circulating water temperatures, &c., are only constant for each particular unit and load. The effect of variations of the initial conditions is negligible in comparison to the effect of variations of the final or terminal conditions, and the amount of coal wasted annually through poor condenser performance must reach an alarming figure.

For instance, consider a 15,000-kW generating unit operating at full load, and the condenser absolute pressure only one-tenth of an inch of mercury greater than the specified value. In this particular case the effect of this increase of absolute pressure is to increase the steam consumption of the unit by approximately 0.10 lb. per kilowatt-hour. With coal at 20s. per ton, and the unit in operation for, say, 10 hours per day, the increased steam consumption means an increase of £1 per day on the coal bill of the station. Certainly not a great sum, but nevertheless a sum that could, and should, be saved. If now, the same unit under similar load and load factor conditions were operating with a condenser absolute pressure 1.00 inch of mercury greater than the specified value, a figure by no means uncommon in many generating stations throughout the country, the loss in this case would amount to something like £1 per hour, equivalent to throwing money away at the rate of over £2,000 per year. The foregoing emphasises the necessity of efficient condenser performance and this can only be maintained if the condensing plant is equipped with the necessary instruments, the operating engineers provided with data showing the correct combination of conditions for each machine and load, and the plant in general maintained in a good state of repair.

Under daily operating conditions the measurements involved in checking condenser performance are:—

(1) Height of barometer in inches of mercury.
(2) Vacuum at turbine exhaust flange or entry to condenser.
(3) Vacuum at bottom of condenser.
(4) Temperature of condensate leaving condenser.
(5) Temperature of inlet circulating water.
(6) Temperature of outlet circulating water.

Reliable and accurate instruments are imperative if the best results are to be obtained and only mercury filled U-tubes should be used for vacuum measurements. A serviceable gauge of this type, described in a previous article on "Turbo-alternator Tests,"* can be constructed for quite a small outlay. Temperature measurements can be made by ordinary thermometers placed in oil or mercury-filled pockets, but as these pockets are often of necessity in rather inaccessible positions, it is a much better plan to measure the temperatures by means of resistance thermometers. The latter method permits of the indicator and plug-board being mounted on the gauge panel of the unit in an easily observable position at the steam end of the turbine. If the mercury columns are also mounted at this point the arrangement ensures that the initial and terminal conditions of the unit are always under the eye of the operating engineer.

For test purposes, and where accurate results are

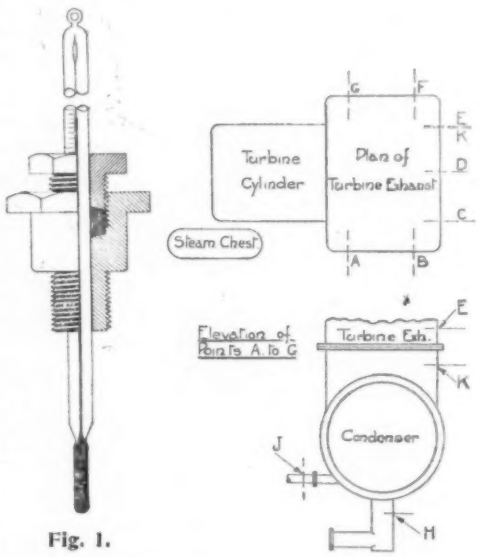


Fig. 1.

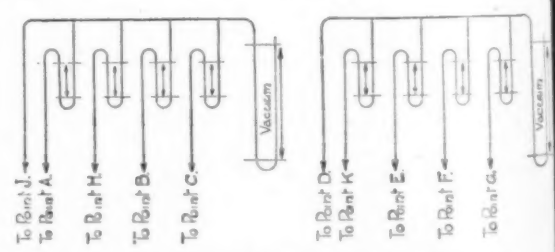


Fig. 2.—Arrangement of Vacuum and Differential-Pressure Gauges.

*ELECTRICAL REVIEW, January 4th, 1924.

desired, temperature measurements can only be satisfactorily made by mercurial thermometers reading to, at least, one-tenth of a degree Fahrenheit. These thermometers should be inserted through special glands as described in "Turbo-alternator Tests." A suitable form of gland showing a thermometer in position is shown in fig. 1, which is a part section, half full size.

Test work, especially in the case of new plant, occasionally involves the determination of the various pressure drops throughout the condenser and air trunk.

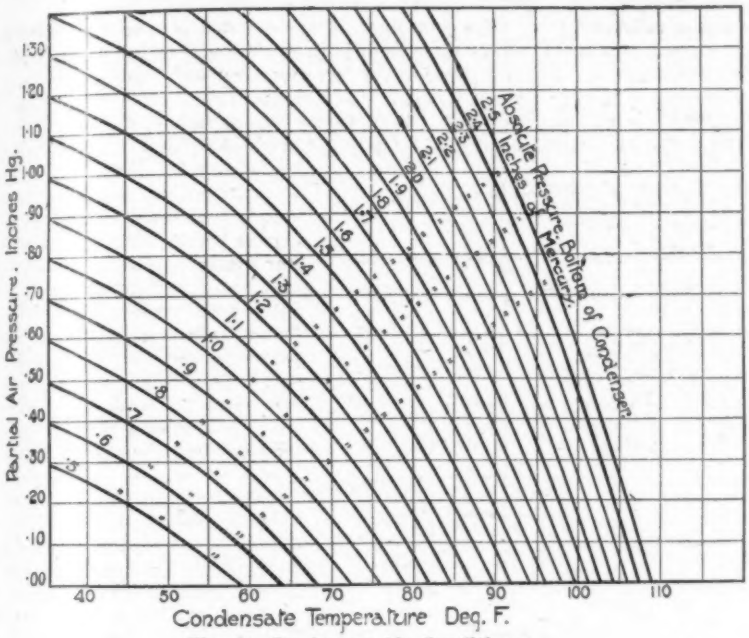


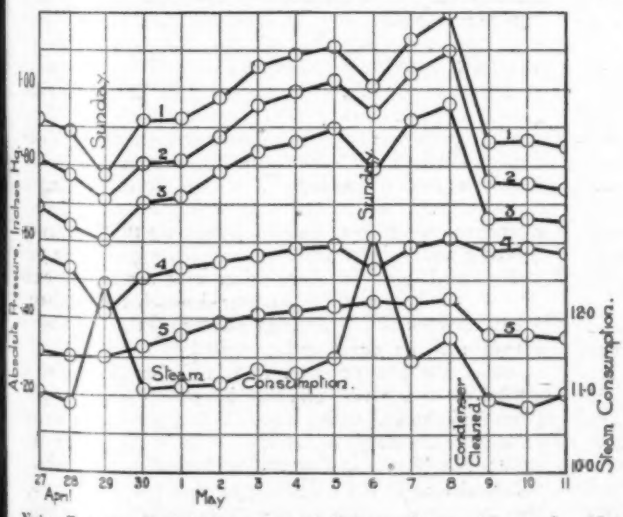
Fig. 3.—Condenser Air Conditions.

These small pressure differences cannot be accurately measured by subtracting the mercury column readings. Differential gauges should be used for this purpose, the measuring liquid being either water or a mixture of water and glycerine coloured with a dye to give prominence to the indications. It is a simple matter to obtain a factor to convert the readings to the mercury equivalent. When using gauges of this description, care must be taken to exhaust the connecting tubes simultaneously by means of suitable by-passes, otherwise there will be a danger of the measuring liquid being drawn into the condenser when the first connection is opened. Fig. 2 shows diagrammatically an arrangement of differential gauges erected for test purposes on an 18,750-kW unit.

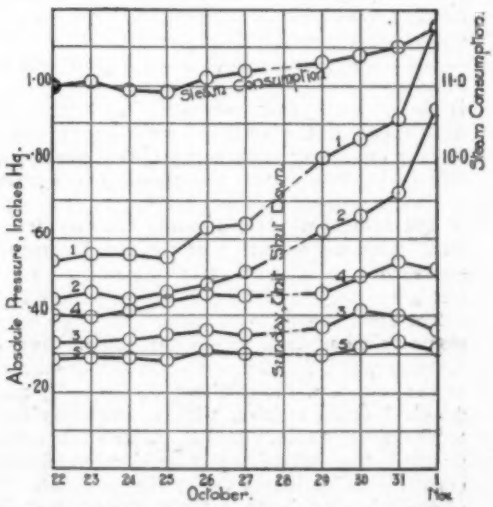
The three principal causes of poor condenser performance are, infiltration of air, dirty condenser tubes, and insufficiency of circulating water. Of these, the most common cause is the infiltration of air. In addition to the air carried over to the condenser by the turbine steam, there will be a further quantity, depending upon the air-tightness of the plant, drawn into the condenser shell or air trunk due to leaks at joints, glands, &c. Particular attention should be given to the low-pressure end of the turbine, exhaust-hood, main low-pressure gland, and the seats and seals of valves under vacuum.

The total absolute pressure in a condenser is the sum of the pressure corresponding to the temperature of the vapour and the pressure of the air. With a given set of conditions, and a constant rate of condensation, the relation between these two partial pressures will vary across the height of the condenser, the air richness being greatest at the bottom. If comparative figures are desired, it is necessary that absolute pressure and temperature measurements be made on a common plane. Theoretically, the partial pressure of the air is the difference between the total absolute pressure and the vapour pressure of the water at the temperature of condensation. Owing to the difficulty of accurately determining the actual temperature of condensation, it is the practice, in the case referred to in this article, to take the vapour pressure as being that corresponding to the temperature of the condensate leaving the condenser. By doing so, the air tension can readily be determined by measuring the absolute pressure at the bottom of the condenser, and also the temperature of the condensate at this point. For instance, with a total absolute pressure of 1.00 inch of mercury at the bottom of the condenser, and a condensate temperature of 75 deg. F., which corresponds to a vapour pressure of 0.873 inch of mercury, the partial pressure of the air at this point is 0.127 inch of mercury, a value representative of very efficient condenser performance, but nevertheless one that should be easily maintained with a modern plant.

The maintenance of efficient condenser performance demands exacting supervision and unceasing vigilance on the part of the operating staff, and to obviate calculations and provide a ready reference from which con-



Note effect on absolute pressures of dirty condenser, increased c.w. inlet temperature, and clean condenser.



Note increasing air leakage from October 26th. Circulating water approx. constant at 25,000 gals. per min.

Figs. 4 and 5.—Daily Records of Condenser Performance.

denser conditions can be judged, use should be made of charts showing standards of performance. These charts can be in the form of blue prints, framed and hung on the wall opposite the units to which they refer. As an example, the chart fig. 3 can be used for readily determining the value of partial air pressure. The curves show total absolute pressure in inches of mercury at the bottom of the condenser, the abscissæ and ordinates being values of partial air pressure and condensate temperature respectively. The use of such a chart requires very little explanation. For instance, with an absolute pressure of 1.00 inch of mercury, and a condensate temperature of 75 deg. F., the value of the partial pressure of air is seen to be 0.127 inch of mercury as previously calculated. Thus from the indications of only two instruments, condenser air conditions can be checked.

The use of instruments further provides a ready means of systematically recording condenser conditions from day to day. It is recommended that con-

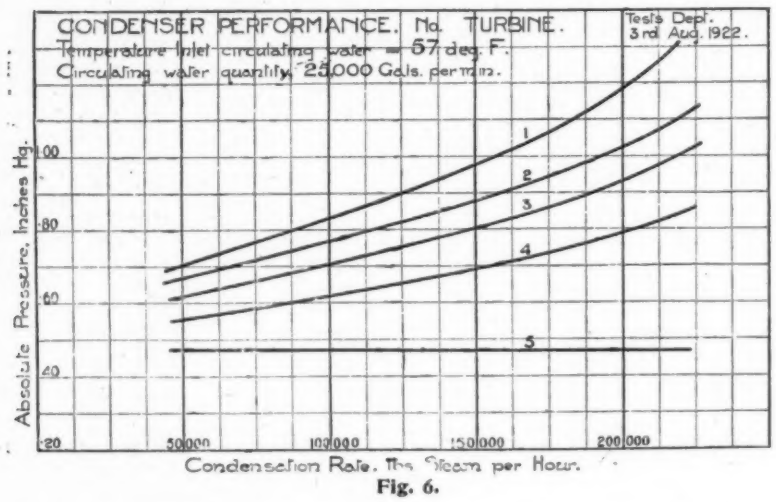


Fig. 6.

denser records be kept in the form of graphs. By doing so the trend of the various values can be seen at a glance. Figs. 4 and 5 show the condenser records, over a period, for two different condensers of 18,750-kW generating units. Graphs of this description provide valuable information regarding the state of cleanliness and air tightness of the condenser. In the examples given, graph 1 is the absolute pressure at the top of the condenser, graph 2 is the absolute pressure at the bottom of the condenser, graph 3 is the vapour tension corresponding to the temperature of the condensate, graph 4 is the vapour tension corresponding to the temperature of the circulating outlet water, and graph 5 is the vapour tension corresponding to the temperature of the circulating inlet water. In each case, the points plotted are the averages, calculated from half-hourly readings of the indicating instruments. As the daily average load, with the exception of the Sunday load, on each set over the period was fairly constant, a graph showing steam consumption is included as a matter of interest.

The difference between graph 1 and graph 2 shows the steam friction drop across the tubes. The difference between graph 3 and graph 4 shows partial air pressure at the bottom of the condenser. Generally speaking, if graph 1 tends to rise, with a corresponding upward tendency of graphs 2 and 3, and a drop in the case of graph 4, this indicates a reduced rate of heat transference due to fouling of the cooling surfaces. This state of conditions is shown in fig. 4, the effect of the fouling being further aggravated by the increasing temperature of the inlet circulating water. By considering each case on its own merits a point can be estimated beyond which the cost of cleaning the condenser is exceeded by the loss due to operating the unit at the increased absolute pressure. Just previous to reaching this point the condenser should be cleaned, preferably by boiling out with a strong solution of soda ash. Where the fouling is due to glutinous clinging mud, occasioned by micro-organical growths of algæ or amoeba type, sterilisation of the circulating water is the only remedy.

An upward tendency of graphs 1 and 2, accompanied by a constant value or a decrease of graph 4, shows either an air leak or inefficient or overloaded air pump. An insufficiency of circulating water will be indicated by an abnormal rise of all graphs with the exception, of course, of the graph of circulating water inlet. On the other hand, too great a quantity of circulating water will tend to decrease the values shown by the graphs and possibly result in excessive under-cooling of the condensate, as in fig. 5. Fig. 5 also shows the start and development of an excessive air leak.

Frequent tests throughout the year, on the condensing plant of each unit in a station, provide a standard of performance for the operating staff, covering the range of circulating inlet water temperatures met with in practice. It is necessary, of course, that the tests be conducted with the plant in first-class condition. Each test should be divided into three or four periods during each of which a different steam weight can be handled by the condenser. For instance, a test of a duration of eight hours would be divided into three periods, each of two hours, allowing the condenser performance to be determined at, say, half-load, three-quarter-load, and full-load, with half an hour between each period to allow the new conditions to be set.

If tests of this nature are to form a standard of performance, it is imperative that they be conducted as accurately as possible, particular attention being given to the measurement of absolute pressure and temperature values. The results of such tests can be clearly expressed in a graphical manner on squared paper, condensate and circulating water inlet and outlet temperatures being converted to corresponding vapour pressures for this purpose. If the values for each load, expressed as absolute pressures, be plotted against the corresponding weight of steam handled, a series of curves will be obtained, which can be taken as representative of the condenser performance of the unit, at that particular circulating water quantity and circulating water inlet temperature. The deductions from such a set of curves can be made in a similar manner to that described above. If these curves are to be used for comparing the condensing plant performances of different sized units, weight of steam condensed per square foot of cooling surface per hour should be substituted for total weight of steam handled. A set of curves showing the condenser performance of a large unit is shown in fig. 6. A series of these sets of curves, covering the various circulating water inlet temperatures throughout the year, and plotted from readings taken with a constant quantity of circulating water passing through the condenser, provides a basis from which another set of interesting curves can be computed. The latter will show the value of absolute pressure at the top or bottom of the condenser for given circulating water inlet temperatures and rates of steam flow. It is a good plan to have all charts showing standards of condenser performance framed, and hung in the turbine room in readily observable positions in the neighbourhood of the units to which they refer. If some form of apparatus is used for metering and indicating the weight of steam or condensate taken by each unit, condenser performance can be quickly checked by noting the rate of steam or condensate flow and absolute pressure and referring these to the standards shown on the charts.

In conclusion, the writer desires to record his thanks to Mr. R. B. Mitchell, M.I.E.E., for his permission to publish the data in this article referring to the operation of Dalmarnock power station.

The Excitation of Synchronous Machines.

The Use of Distributed Exciting Windings and Uniformly-slotted Exciting Members.

By R. G. JAKEMAN, B.Sc.

DISTRIBUTED exciting windings wound on uniformly-slotted rotors or stators are used chiefly for self-starting synchronous motors (synchronous induction motors). It is also found desirable to employ them for alternators, either for very small sizes or for medium sizes at high speeds where the small number of poles makes the salient-pole type impracticable.

In the case of synchronous motors it is most usual to wind the exciting member with an ordinary two-layer three-phase star-connected winding, and introduce the direct-current excitation by one of the two methods shown in figs. 1 and 2. It will be noted that in fig. 1 one phase carries twice the current in either of the other two phases, and in fig. 2 one phase carries no current at all.

Open-circuit Excitation.—The necessary exciting current

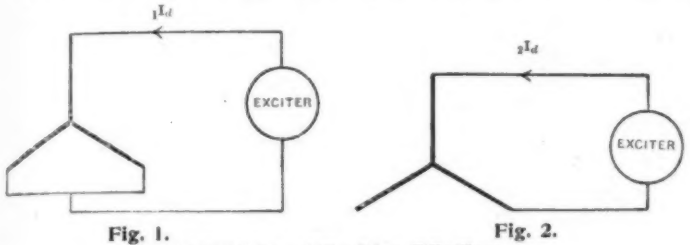


Fig. 1. Fig. 2.

Connections of Exciting Winding.

on open circuit with the connections shown in figs. 1 and 2 can be calculated in the following simple way. If the machine were excited by means of a three-phase current in the exciting winding, the m.m.f. of the alternating current would alternate between a pointed shape and a flat-topped shape (figs. 3*a* and 3*b*.)* The pointed shape occurs when the current in one phase is a maximum and is twice the current in the other two phases, while the flat-topped shape occurs when the current in one phase is zero and in the other two it is 0·866 of the maximum. The fundamental of these two shapes is the same.

Now with the connection shown in fig. 1, the direct current in one phase is double that in the other two and the m.m.f. has the pointed shape just as fig. 3*a*.

For a given flux there are several convenient methods of calculating the three-phase excitation necessary, so that the m.m.f. shape in fig. 3*a* can be drawn to scale by taking the current in one phase at its maximum and in the other two phases at half the maximum. To produce the same flux with direct-current excitation, fig. 3*a* has to be duplicated, and this occurs when the direct current in one phase is equal to the maximum value of the alternating current, calculated by any convenient method, the current in the other two phases being half that value since they are connected in parallel.

In a similar way, the connection shown in fig. 2 gives an m.m.f. of the flat-topped shape in 3*b*. The direct-current excitation is therefore 0·866 of the maximum value of the calculated alternating current.

General Method.—This explanation only holds for the usual methods of connection shown in figs. 1 and 2. A simple method of calculating the direct-current excitation for any connection of the exciting winding will now be developed.

In order that the excitation produced by various methods of connection shall have the same effect, it is necessary that the fundamentals of the m.m.f. waves be equal †

If the excitation is produced by three-phase current, the r.m.s. value of the current necessary is $I_a = \text{AT}/k_1\, g'z$, where AT = ampere-turns per pole-pair for the given flux, calculated according to one of the known methods for three-phase induction motors, k_1 = a constant depending on the method of calculation used, g' = slots per pole and phase in the exciting winding, and z = conductors per slot in the same. The maximum ordinate of the peaked wave in fig. 3*a* is $\sqrt{2}\, I_a\, g'z$, and the amplitude of the fundamental is $0{\cdot}9\ \sqrt{2}\, I_a\, g'z$. We have above $I_a\, g'z = \text{AT}/k_1$, so that the amplitude of the fundamental is $1{\cdot}27\ \text{AT}/k_1$. It will be seen that this value is independent of the number of slots in the exciting winding.

Exciting now with direct current and taking the connection in fig. 1, for which the m.m.f. wave is peaked, as in fig. 3*a*, the maximum ordinate is $_1I_d\, g'z$, where $_1I_d$ is the direct-current excitation, so that the amplitude of the fundamental is $0{\cdot}9\ {}_1I_d\, g'z$.

We have therefore $0{\cdot}9\ {}_1I_d\, g'z = 1{\cdot}27\ \text{AT}/k_1$

$$_1I_d = \sqrt{2}\ \text{AT}/k_1\, g'z.$$

This agrees with the previous explanation that the direct-current excitation equals the maximum value of the three-phase exciting current.

For fig. 2, we have the flat-topped wave like fig. 3*b*. The maximum ordinate is $_2I_d\, g'z$, and the amplitude of the fundamental is $1{\cdot}04\ {}_2I_d\, g'z$, which again equals $1{\cdot}27\ \text{AT}/k_1$.

Hence $_2I_d = 1{\cdot}22\ \text{AT}/k_1\, g'z\ (= 0{\cdot}866\ {}_1I_d)$.

To compare the losses in figs. 1 and 2, let R = resistance per phase. The total loss for fig. 1 is then $_1I_d^2\ \text{R} + 2\ (_1I_d/2)^2\ \text{R} = 1{\cdot}5\ {}_1I_d^2\ \text{R}$.

For fig. 2 the loss is $2\ {}_2I_d^2\ \text{R}$, which, since $_2I_d = 0{\cdot}866\ {}_1I_d$, is equal to $1{\cdot}5\ {}_1I_d^2\ \text{R}$, and is therefore the same as for fig. 1.

In both cases the loss is not evenly distributed over the periphery.‡

In both cases the m.m.f. wave is practically sinusoidal.

In order that the loss should be evenly distributed over the periphery, the connection shown in fig. 4*a* has been used, where one phase is connected in two parallel paths. All the conductors carry the same current, so that the m.m.f. has a triangular shape (fig. 4*b*), of which the maximum

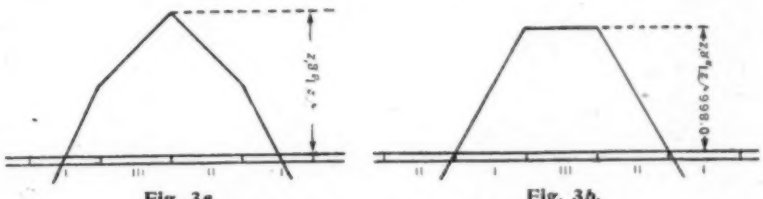


Fig. 3*a*. Fig. 3*b*.

M.m.f. Shapes for Three-phase Excitation.

ordinate is $(_1I_d/2)\ (3\ g'z/2) = 0{\cdot}75\ {}_1I_d\, g'z$. The amplitude of the fundamental is 0·8 of the maximum ordinate, and is therefore $0{\cdot}6\ {}_1I_d\, g'z$, which again equals $1{\cdot}27\ \text{AT}/k_1$.

Hence $_1I_d = 2{\cdot}12\ \text{AT}/k_1\, g'z\ (= 1{\cdot}5\ {}_1I_d)$.

The total loss is $2\ (_1I_d/2)^2\ \text{R}/2 + 2\ (_1I_d/2)^2\ \text{R} = 0{\cdot}75\ {}_1I_d^2\ \text{R} = 1{\cdot}7\ {}_1I_d^2\ \text{R}$, which is 13 per cent. higher than for fig. 1. The loss, however, is evenly distributed over the periphery.

The m.m.f. wave has an 11 per cent. third harmonic, and a 4 per cent. fifth harmonic. Neglecting saturation, these cause in the phase pressure wave a 7·7 per cent. third harmonic and a 0·9 per cent. fifth harmonic.

Another method is to connect as for fig. 4*a*, but to wind with a two-thirds coil-pitch. The m.m.f. wave will then be flat-topped exactly as fig. 3*b*, and the current per con-

* S. P. Smith and W. H. Barling, *The Electrician*, Vol. 74, p. 42.

† Hawkins, Smith, and Neville, "Papers on the Design of Alternating-current Machinery," p. 138.

‡ Curves showing the heating of each phase are given by Ganapati and Parikh, *Journal* I.E.E., Vol. 61, p. 796.

ductor will be the same as ${}_3I_d$, the total excitation current being $2\ {}_3I_d = 2{\cdot}45\ \text{AT}/k_1\ g'z\ (= 1{\cdot}73\ {}_1I_d)$.

The total loss will be $3\ {}_3I_d{}^2\ \text{R} = 2{\cdot}25\ {}_1I_d{}^2\ \text{R}$, which is 1·5 times the loss for fig. 1, but the loss is evenly distributed.

The m.m.f. wave is practically sinusoidal.

Alternators.—In the case of alternators, it is not necessary that the number of slots per pole should be divisible by 3. For instance, there may be 10 slots per pole, of which 8 are occupied by the exciting winding, the other two containing a short-circuited winding for damping.

With the connection shown in fig. 2, the m.m.f. shape will be as fig. 5. The value of α is determined by the equation $\alpha/\pi = g_1/2g$, where g = total number of slots per pole and g_1 = number of wound slots per pole. For

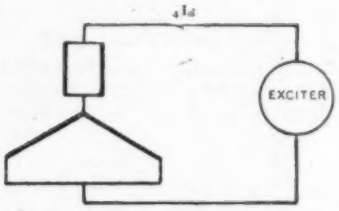


Fig. 4*a*.—Connections of Exciting Winding.

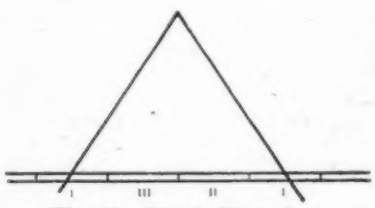


Fig. 4*b*.—M.m.f. Shape for Fig. 4*a*.

instance, in the example given above, $g = 10$ and $g_1 = 8$.

The maximum ordinate of fig. 5 is $y = {}_3I_d\ g_1\ z/2$ and the amplitude of the fundamental is $(4y/\pi\alpha)\sin\alpha = (8yg/\pi^2 g_1)\sin(g_1\pi/2g) = (4/\pi^2)\ {}_3I_d\ gz\sin(g_1\pi/2g)$.

Hence we have $(4/\pi^2)\ {}_3I_d\ yz\sin(g_1\pi/2g) = 1.27\ \text{AT}/k_1$,

$${}_3I_d = 3{\cdot}2\ \text{AT}/k_1 yz\sin(g_1\pi/2g).$$

A further method is obtained by connecting as in fig. 1 but having unequal numbers of conductors in the three phases. For instance, with 10 slots per pole, the phase carrying the total current may have 4 slots per pole and the other two phases 3 slots per pole each. The m.m.f. shape will be as fig. 6, in which $\alpha/\pi = g_2/2g$, where g = total number of slots per pole and g_2 = number of slots per pole which carries the phase in the total current.

The ordinate at the angle α in fig. 6 is $y = {}_6I_d\ g_2\ z/2$, and the amplitude of the fundamental is $(2y/\pi\alpha) + 1\ (\sin\alpha)$

$$= (4yg/\pi^2 g_2)\ (1 + \sin(g_2\pi/2g))$$
$$= (2/\pi^2)\ {}_6I_d\ gz\ (1 + \sin(g_2\pi/2g)).$$

Hence we have $(2/\pi^2)\ {}_6I_d\ gz\ (1 + \sin(g_2\pi/2g)) = 1.27\,\text{AT}/k_1$

$${}_6I_d = 6{\cdot}35\ \text{AT}/k_1 gz\ (1 + \sin(g_2\pi/2g)).$$

Armature Reaction.—Since the magnetic reluctance is uniform all round the periphery, the armature reaction produces an m.m.f. which is practically sinusoidally distributed. This m.m.f. can therefore be added vectorially to the m.m.f. necessary to produce the flux, in order to obtain the total m.m.f.§

The simplest method is to convert the armature m.m.f. into terms of ampere-turns calculated according to the $0{\cdot}9\ \sqrt{2}\ I_s g_s' z_s$, where the suffix s refers to the armature winding. It has been shown above that the amplitude of the fundamental for 3-phase excitation is $1{\cdot}27\text{AT}_s/k_1$, where AT_s denoted the ampere-turns per pole-pair provided by the armature current, for the particular method of calculation we are using. Hence $\text{AT}_s = k_1 I_s g_s' z_s$. AT_s can now be added vectorially to the AT for the flux and the result converted into direct-current excitation.

Two-phase Armature Reaction.—The m.m.f. of a full-pitch two-phase winding varies between a flat-topped and a triangular shape, as shown in fig. 7.‖

The amplitude of the fundamental of these shapes is $0{\cdot}8\ I_s g_s' z_s$. Hence $\text{AT}_s = 0{\cdot}63\ k_1 I_s g_s' z_s$.

Single-phase Armature Reaction.—The m.m.f. of a single-phase winding is flat-topped or triangular, according as the winding covers part or the whole of the periphery. The amplitude of its fundamental at the maximum value of the current is

$$(4/\pi^2)\ \sqrt{2}\ I_s g_s z_s \sin(g_{1s}\pi/2g_s),$$

where g_s = total number of slots per pole and g_{1s} = number of wound slots per pole.

As is well known, this can be resolved into two waves, each of half the amplitude, revolving in opposite directions. Only the synchronously rotating wave has to be dealt with, the other being damped out as far as possible by the damping winding.

We have therefore $\text{AT}_s = 0{\cdot}223\ k_1 I_s g_s z_s \sin(g_{1s}\pi/2g_s)$.

For a winding in which two-thirds of the periphery is wound, this becomes $\text{AT}_s = 0{\cdot}29\ k_1 I_s g_{1s} z_s$.

When the value of the armature reaction has been found, the ampere-turns can be added vectorically to those for the flux, at an angle determined by the power factor and the armature impedance. Due regard must be given to the field leakage, but this is comparatively small, and is practically limited to slot leakage if no end-bells are used.

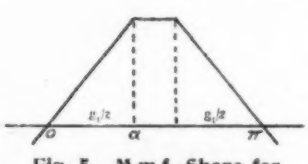


Fig. 5.—M.m.f. Shape for Alternator.

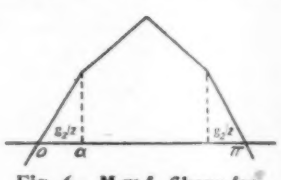


Fig. 6.—M.m.f. Shape for Alternator.

The table gives the value of k_2 for the various methods of connecting three-phase windings, where $I_d = k_2\ \text{AT}/k_1\ g'z$.

Connection.	k_2.	k_1.
Fig. 1	1·414	0·67
Fig. 2	1·22	0·58
Fig. 4 (full pitch)	2·12	1·0
Fig. 4 (⅔ pitch)	2·45	1·15

One method of calculating the three-phase excitation,

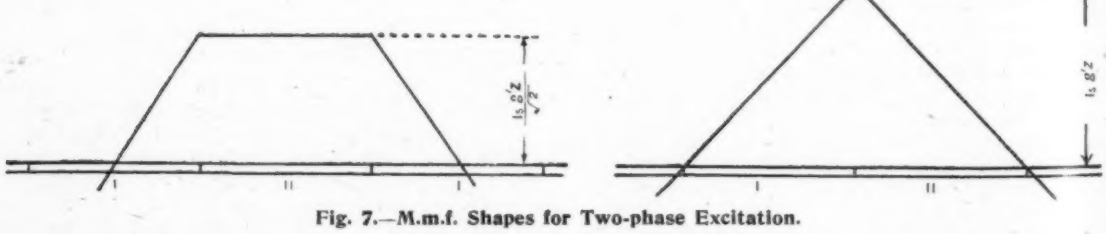


Fig. 7.—M.m.f. Shapes for Two-phase Excitation.

method which is being used, add these AT vectorially to the AT for producing flux, and then convert to direct current by means of one of the above formulæ, according to which method of connection is used on the exciting member.

Considering first of all a three-phase armature winding, the amplitude of the fundamental of the m.m.f. wave is which gives very good results even at high saturation, consists in calculating the AT for a value of the flux-density equal to 1·28 times the mean density.¶ The corresponding value of k_1 is 2·12.

In the table, $k_2 = k_2/2.12$, so that for this method of calculation, the direct-current excitation is $I_d = k_2\ \text{AT}/g'z$.

§ Miles-Walker. "Specification and Design of Dynamo electric Machinery." p. 279.

Hawkins, Smith and Neville. Papers on the "Design of Alternating-current Machinery," p. 38.

‖ The amplitudes of the harmonics of lower orders in these shapes are excessive. With two-layer windings they can be considerably reduced by using a shortened pitch.

¶ Kloss, *Elektrotechnik und Maschinenbau*, 1910. Smith and Barling, *Electrician*, Vol. 74, p. 42.

Electrical Progress in South America.

Argentine Market for Electrically-Propelled Street-Cleaning Apparatus.—Brazil's First Electrical Steel Furnace.—Mexican Electrical Possibilities.

[FROM OUR SPECIAL CORRESPONDENT.]

IT is much to be regretted that there should have been no British participation in the latest and largest hydro-electric power enterprise organised between certain North American capitalists and certain of the countries of South America. It has been known for some considerable time past that several of the larger Latin-American States, such as Argentina, Brazil, Chile, and Peru, have been in treaty with foreign capitalists for the augmentation of their electric power supply; and it would have been gratifying to have been able to announce that British enterprise had responded to the overtures made, and had secured at least part of the contracts available. The principal concerns connected with the immense scheme, which calls for the outlay of not less than $50,000,000 gold (£10,000,000), and which has for its object an almost unlimited field of operation in the South American countries, are the General Electric Company (U.S.A.), and its subsidiary the Electric Bond and Share Company.

The financing of the undertaking has been completed satisfactorily, but the actual contracts for construction of the various power stations have not, at the time of writing, been decided upon. Here it is possible to say that those hydro-electric properties which have already been taken in hand have on the whole proved highly successful. Operating costs have turned out to be lower than was expected, and have rendered possible the sale of electricity at rates that cannot be equalled by any other mode of power production. It is, therefore, merely a question of time for the development of the most kilowatt-hours per £ sterling of funded debt in a region that will afford an adequate market for the current produced. Practically the whole of the foreign companies supplying hydro-electric power to Latin-American countries show net earnings higher than twice the requirements for all their debenture interest, a fact which should lend encouragement to further British enterprise, which has already proved equally remunerative in the majority of cases.

Nor are the opportunities afforded to our manufacturers of electrical plant and apparatus confined to the provision of power for industrial purposes. The progress made in wireless telegraphy and telephony places at the disposal of the community at large enormous resources which are as yet practically almost untouched, especially in connection with ships and aeroplanes. No country in the world possesses a more highly-trained service of clever young electrical engineers than the United Kingdom; their opportunities in the Latin-American countries remain almost unsuspected. It is to be hoped that the current year will witness a substantial advance in the progress of electrical installations of British manufacture in the progressive Latin-American States.

There has recently arrived in Peru an exceptionally large consignment of electrical material destined for service in connection with the Empresas concern, mainly cables, for the transmission of current in Lima, and the modernisation of the electrical services of the capital. A complete transformation is in view with regard to the laying of the cables, the present unsightly and tangled overhead wires, which greatly disfigure the streets and avenues of Lima, having been condemned. These are destined soon to disappear, the whole of the new cable-work to be carried out being subterranean, replacing the existing aerial system. The new installation consists of 50 km. of cable, having a weight of approximately 480 tons. The cables are of the most modern type consisting of three cores of insulated copper wire, the whole being sheathed with jute, lead and waterproof material.

The Buenos Aires city authorities are again in the market for motor-propelled vehicles, the tests made with one or two street-cleaning machines worked by electricity having proved pre-eminently successful. Ninety-nine per cent. of the scavenging, watering, and the removal of household refuse is still performed by horse or mule-drawn wagons. The few motor-lorries introduced have, however, convinced the authorities that these are the vehicles of the future. Not only has the cleaning work been better carried out, and in a more expeditious manner, but the municipal wages bill, which has borne heavily upon the resources of the city, has been materially reduced. It is satisfactory to know that among the tests carried out between British, German, and American motor-vehicles, the British have proved to be in many ways superior. The unfortunate fact remains, however, that German competition in regard to prices is proving a serious obstacle to firm orders being placed in this country. A representative of Krupps, at present in Buenos Aires, is pursuing actively a detailed study of the municipal needs, and preparing for submission full specifications relative to the various classes of street-cleaning vehicles operated by electricity required. If British manufacturers could see their way to cut down their quotations and, at the same time, offer liberal credit facilities, there is little doubt that a considerable portion (if not the whole) of the orders available would find its way to their workshops. The city of Buenos Aires is about to raise a loan, not exceeding $50,000,000 (paper), equal to about £4,500,000, for the purpose of installing electrical cleaning apparatus in the city as well as other municipal mechanical appliances. The favourable situation should certainly attract the attention of British exporters of road-sweeping and other motor-vehicles.

In Brazil, the Companhia Paulista, which, during the past twelve months has successfully operated an electric freight and passenger railway service 44 km. in length between Jundihay and Campinas, is now engaged upon preparing plans and placing contracts for the electrification of a further 50 km. of its trunk line, extending from Campinas to Tatu. A preliminary order has been placed for five 56-ton locomotives, each employing 3,000 volts continuous current; the full equipment for a sub-station; and the whole of the necessary apparatus and material for a length of 46 km. of double transmission line.

The first all-electric steel furnace ever worked in South America has recently been completed in Brazil. The locality selected is Ribeirao Preto, which although a small place is credited with possessing the greatest reserves of iron-ore in the world. Electric steel-making in Brazil is the result of an attempt to utilise electrical energy during the off-peak season. Already, some hydro-electric plants have been worked by the Empreza Forca é Luz de Ribeirao Preto. These constructions have gradually extended until they now form a network of transmission lines, serving a large number of coffee plantations. Each is required to furnish 100 h.p. to drive the necessary machinery for cleaning the hulls from the coffee-beans, the largest demand for power being in the months of June, July, and August. Unfortunately, these are three of the driest months of the year, when the local streams offer a minimum flow of water. During the remaining period of the year a considerble volume of developed and an enormous volume of undeveloped power has always been available.

but not made use of. This fact has weighed considerably with the *entrepreneurs* of the new steel plant, who decided to make use of the wasted water power for the furnishing of electricity for their steel mills. A purchase was made under the exclusive South American rights of the Swedish type of electric pig-iron furnace, two of which have now been installed, each with electrical transformers, and complete in all respects. Only one will be operated for the time being, but probably before the end of the year the other will be placed in service. Current is received at 30,000 volts, 50 cycles, and will be transformed out-doors to 6,000 volts, whence it will be conducted by lead-covered cables to the substation adjoining the mill building. Each pig-iron furnace will be provided with three 1,500-kW water-cooled transformers, constructed especially for this service. The secondary will deliver any voltage, from 60 to 120 volts. Each furnace will have six 24-in. carbon electrodes, while adjacent electrodes will be connected to the same phase.

The Mexican Government has recently commissioned a body of consultative electrical engineers consisting of five members, and to be known as the Commission for Promotion and Control of the Power Generation Industry, to report to the departments of Agriculture and Promotion of Industry and Commerce, upon further electrical power possibilities in the country. The members of the Commission have already set to work, but they have been seriously interrupted in their duties by the prevailing revolution. It is not improbable that their operations will have to be suspended until a more settled condition prevails in the country.

Saorstat Eireann (Irish Free State).

Reports of the Fiscal Inquiry Committee.

By Robert N. TWEEDY.

ALTHOUGH the Government is so strong, in the absence of the Republican Deputies, as to be tempted almost inevitably into reactionary paths, it did a very shrewd and statesmanlike thing in appointing a Fiscal Inquiry Committee consisting entirely of specialists in economics. The outcry from the industrialists may be imagined. The hard-headed business man's sense of decency of proportion, of perspective, of brass tacks, of anything you like, was outraged.

You know . . . professors . .phoo! Economists—professional economists . . . . Bah! . . . Historians, grubbers in libraries, musty-brained theoreticians . . . pss-s! . . . What can they know about the realities of business? . . .

The Irish daily Press, the Dáil, the streets, the cafés, clubs, offices, and farmhouses echoed and resounded with fulminations against the amateurish ignorance and misguided folly of the Executive Council.

The Committee issued two interim Reports* recommending:—

(*a*) The repeal of Part I of the Safeguarding of Industries Act, 1921, on the grounds that the provisions of that part of the Act were framed with regard for the peculiar needs of certain industries which, though important in Great Britain, are insignificant in the Free State, and that they increased the cost to the consumer of useful or necessary commodities without producing any adequate return to the public revenue. Scientific and educational establishments in particular are adversely affected by this Act.

(*b*) The repeal of the Dyestuffs (Import Regulation) Act, 1920, for the even stronger reason that there is no Free State dyestuffs industry to be protected, and the effect of the Act is merely to protect other countries against the textile and other industries of the Free State.

(*c*) Certain Revenue Prohibitions to be retained.

(*d*) The import duty upon alcohol contained in spirit varnish for use in industrial processes to be waived.

(*e*) The withdrawal of duties upon motor accessories and components.

In the Final Report, the Committee suggests further with respect to motor-cars, that a much lower rate of duty shall be levied upon the chassis when imported without the body, in order to encourage body-building in the Free State.

Other than that there is no definite recommendation in the Final Report, for the President of the Executive Council had stated in the Dáil that this Committee was appointed to ascertain and inform the community as to all the facts of the industrial situation as it existed, and upon the probable effect of any changes in the fiscal policy. It was not for the Committee to advocate policy. That was matter for the people and the Government to decide when the Committee had completed its work.

Nevertheless, it is impossible to read the Report without visualizing the recommendations that the Committee would have made had it been entitled to go so far. You, in Great Britain, will rejoice or be sad, as you are Free Traders or Protectionists, when you hear that the Committee appears to be totally opposed to protection for Irish industries as a general policy.

The particular case of every industry about which evidence was received is examined in the Report with care, and the effect of protection upon it and upon Irish industry as a whole is discussed. By no means all witnesses advocated protection, and the most valuable feature of the Report is the clear demonstration that what is one man's meat is another's poison. The flour millers, for instance, say that their industry is declining and must perish unless protected. A biscuit maker, employing about 3,000 hands in Dublin, and doing a great export business in spite of all his handicaps, said that a general tariff would be so injurious to him that the export part of the business would have to be removed to another country.

The representatives of the workers in the flour mills strongly opposed a tariff, because they held that it would raise the cost of living, and that the state of the native milling trade was due to causes within the industry, such as small plants, poor business organisation, and inefficient machinery.

There are only two grounds upon which a case can be made for protection. One is the encouragement of nascent industries, the other the protection of established industry from what is called unfair competition. Of the first class, it is fair to conclude from the Report that there are none. There may be many in some stage of conception or gestation, but there are none newly born or within a long cry of that delicate stage. What we do find, however, is a kind of industry which, like some womenkind, acknowledges no gradation between youth and senility. Some of the industries represented by witnesses before the Committee seemed to be unaware that their buildings, plant, technique, organisation, and staff might be described more accurately as obsolescent than as nascent.

In the second class there are some industries which do appear to be unwarrantably hard hit by foreign competition, but the trouble about them is that their maxi-

* Reports of the Fiscal Inquiry Committee. Price 1s. 6d. net (postage extra). Eason & Son, Ltd., 40-41, Lower O'Connell Street, Dublin.

mum possible output is not nearly large enough to supply the present demands of the home market. In the case of the boot trade, for example, a tax on imported boots heavy enough to level up the difference between them and the home-made article would have to be in operation long enough to permit the Irish output to expand to at least fifteen times its present figure, and to develop the better-class lines which are not touched now. Much the same thing can be said of the other industries in our second class.

Then there is the case of the industry which does not exist, and never did exist in Ireland, for the very good reason that the maximum demand has not been sufficient to attract capital to set up factories. Only one witness wanted a tariff under such conditions, and this isolated case is particularly interesting to readers of the ELECTRICAL REVIEW, because the articles sought to be protected are lamps and batteries. The witness stated that a tariff of 20 per cent. on imports of both these articles would enable them to be made successfully in the Free State. He said that the manufacture of lamps would be mainly an assembly of glass, wire, and brass imported, but Irish patent law would have to be altered in order to get over the difficulty of patent rights, which were now in the hands of large British companies.

This witness had no mandate from the trade in Ireland, so far as can be discovered, but it is said that he could find financial support for the erection and equipment of a lamp factory if the Government could be persuaded to levy a tariff on imported lamps. Probably, this applies also to the battery business. If the policy of protection were to be made stand or fall by an examination of these two schemes, there would be small chance for it. The lamp business is the worse of the two because it is impossible for Ireland to get her neck out of the noose of the master patents held by the lamp ring. All that the Free State Government could do would be to force the patentees to manufacture in Ireland behind a tariff wall, and we should have then the absurd spectacle of a make-believe lamp factory assembling parts made in England or elsewhere, and selling the complete lamp to the consumer through the trade at higher prices than before. There is no question of manufacture for export. The whole output would have to be marketed in the Free State, and there is no hope of the demand reaching the economic output of a *bona-fide* factory, not merely a place of assembly, for many years.

The proposition is one which holds no benefit whatever for the consumer, and may very well land him in a worse place then he is in now, but it does present an opportunity for someone to haul in monopoly profits from the sale of lamps in the Free State.

As things stand, the Government will be well-advised to let British makers continue to take their profits lest worse befall. In years to come perhaps the demand for lamps in a united Ireland will warrant the expenditure of Irish capital upon a factory to supply internal requirements, but the prospect of an export trade would seem to be illusory.

The case of the accumulators is, if possible, weaker than that of the lamps. The present demand for batteries in the whole of Ireland would not provide a satisfactory turnover for one modern factory, and certainly there are no special advantages offering to British or foreign makers to induce them to establish works here for supplying the Free State demand, even if the whole output were to be concentrated in one factory.

A tariff, in order to be effective both in the case of lamps and of batteries, would need to be high enough to inhibit altogether any competition by extra-territorial factories, and the inevitable result of manufacturing upon a small scale behind such a tariff must be disastrous for the consumer, and an incalculable setback to the progress of electrical development in the Free State, which would damage the community far more than it would be compensated by an additional £25,000 or £50,000 in wages.

In view of the settled policy of the Free State Government to sanction no electricity supply undertaking except upon the a.c. system it is not likely that the demand for storage batteries will grow at a rate which would attract manufacturers having the necessary specialised knowledge of technique and general organisation to risk new capital in Ireland.

Returning now to a consideration of the Report as a whole, it is impossible to avoid the conclusion that the Committee was not satisfied with the *bona-fides* of many of the applicants for protection. If a firm goes to a bank for accommodation it will not get it unless all the facts are disclosed under a close examination, and no bank will step in to save a firm from bankruptcy without definite assurances that the organisation and methods of the firm will be overhauled and tightened up in accordance with the requirements of modern industrial economics. Yet here we have whole industries applying to the nation for accommodation in the shape of tariffs or of bounties, and either refusing to supply the necessary financial information or admitting that they themselves are unable to obtain it.

Protection may be a remedy for national ills, but no popular government is going to impose tariffs in favour of manufacturers unless it can see the beneficial effects of those tariffs working their way down through the arteries and veins of the community.

Protection applied to most of the Irish industries as they are to-day would be nothing but a perpetuation by the State of uneconomic methods. It would be a desperate blindfold attempt to rejuvenate senility. What Irish industries want is rebirth into the 20th century, not a monkey gland injection.

Nevertheless, the State has work to do, and much more difficult and delicate work than passing tariff laws. Irish industries can do a lot for themselves, and in doing it can help to solve the unemployment problem, but they cannot hope to compete on even terms with other nations until developments external to themselves have been set afoot. Chief among these are transport, power, and raw materials.

Ireland is better provided with roads, railways, and inland waterways than many more highly industrialised countries, but she lacks a transport policy. It is in the making, and much depends on it.

Ireland has magnificent power resources in her peat and coal deposits, and in the streams and rivers, but she lacks a power policy. It also is in the making, but with clouded vision and uncertain touch. All we can hope is that the clay will be kept plastic and under control until the moulders have acquired the confidence born of clear insight.

Neither are the raw materials of many industries lacking. Given only cheap transport, cheap and widely distributed power, and a sufficient supply of human skill, the soil of Ireland will yield richly.

Unemployment must be faced, and faced immediately, by carrying out the pioneer work which will be the best form of protection for native industries. The two million pounds now being spent on the roads is bread thrown upon the waters. If it be followed by completing the great arterial drainage schemes of the last century, by improving the inland waterways, by large-scale bog-area reclamation for fuel and cultivation, by opening up the proved anthracite and semi-anthracite fields, and by conserving the more important water powers, Ireland in twenty years' time will be, for her size, the richest agricultural nation in the world.

It might be a good thing for many people in Ireland to ponder that paradox.

Londonderry Buys Abroad.—The Londonderry Corporation has passed over a number of British tenders for cast-iron pipes "required for an unemployment scheme" (*Leeds Mercury*), and has placed the order with a French firm at £300 less than the lowest English offer. The Labour representatives urged the case of the British unemployed, but others seemed to think that the result of the General Election was a signal for the opening of the British markets to foreigners. Perhaps the new Government will make it known whether it approves of creating schemes to reduce British unemployment without requiring that the money shall give employment to British workpeople.

Cable-Laying Under Difficulties.

A Successful B.I. & H.C. Achievement.

AN interesting example of electric power cable laying under unusual circumstances, and exceptionally difficult conditions, was carried out at Lydney, on the River Severn, during last September. The object of the cable is to link up the areas of supply served by the West Gloucester Power Co. on the east and west banks of the river, the power station being on the west side at Lydney.

At the point selected for the crossing, the river is approximately 2,000 yards wide, and the conditions for navigating cable-laying craft were extremely difficult owing to the speed and variations of direction of the tide. At low water the greater part of the river bed is exposed in the form of sand banks, leaving a permanent channel under the eastern shore, which, however, is not navigable at low water mainly owing to the presence of rocks. The tide ebbs and flows at speeds ranging up to seven knots under normal conditions, the lift of the tide being 33 ft. at the time the cable was laid, and the period of slack water at the top of the tide is usually less than five minutes.

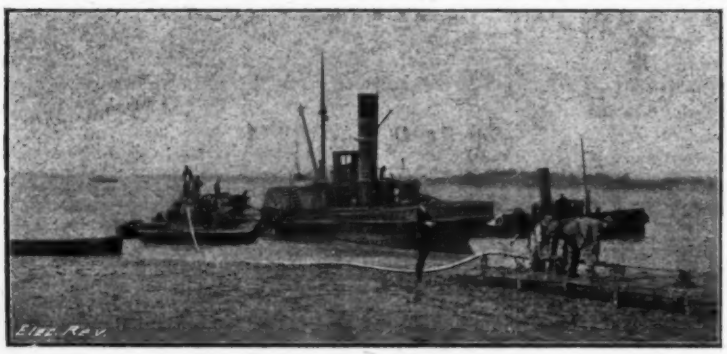


Fig. 1.—Hauling the Cable Ashore

Two cables were laid, each being 0.1 sq. in., 3-core, 33,000-V, double wire-armoured, and the over-all circumference being 12 in. Each cable was built in three lengths consisting of one length of 800 yards for the permanent channel, and two other lengths of about 700 yards each, the joints being made *in situ*. The drums containing the longer lengths were 10 ft. in diameter, and weighed 19¼ tons.

The general scheme devised for installing the cables was that at high water a length of cable should be paid off the drum over a guide block in the stern of the cable barge, and the first barge laid alongside the one containing the second length of cable. The free end of the cable was then passed on to the second barge, secured, and the joint between the two lengths made. The jointing operation occupied some thirty hours, and at the first period of low tide after its completion, the joint was lowered on to the exposed sand, the second length then being ready for laying; and similar operations were gone through for making the second joint.

Favoured by average weather, the laying of the first cable was commenced on September 5th. The cable end was hauled ashore by means of a hand winch, a messy operation carried out on a soft mud bank. Fig. 1 shows this operation in progress. The small tug is backing up against the paddle tug in order to hold her broadside on to the tide. The illustration also shows the second barge moored at the first jointing position.

Fig. 2 shows the laying process in progress immediately after the start. It will be observed that for general control a paddle tug is lashed to the side of the cable barge, this tug providing most of the pulling. Two other tugs are used for maintaining direction, one attached to the bow of the barge and the other to the stern; the funnel of the former can be seen in the photograph. The time occupied in laying was 11 minutes.

Very great difficulty was experienced in holding the barges in position during the jointing process, no fewer than nine anchors being employed simultaneously on each barge. Work proceeded continuously without a break from September 5th to the afternoon of September 10th, when the laying of the first cable was completed. The second cable was laid a fortnight later.

In the bed of the permanent channel, which is of mud, a shallow trench has been cut for the cable to lie in, and bags of concrete have been placed over it. On the sand banks, which vary in depth and formation from tide to tide, the cable has been buried where possible, but for the greater part is being allowed to work its way down by gravity and tide effects.

The construction of the whole system was in the capable hands of the Foundation Co., Ltd., Messrs. Arthur Ellis and Partners, and Mr. W. B. Woodhouse being the consultants. The river cables were manufactured and laid for them by the British Insulated and Helsby Cables, Ltd., Messrs. S. R. Brown & Sons, of Bristol, and Messrs. Duncan, of Middlesbrough, providing and working the various craft employed.

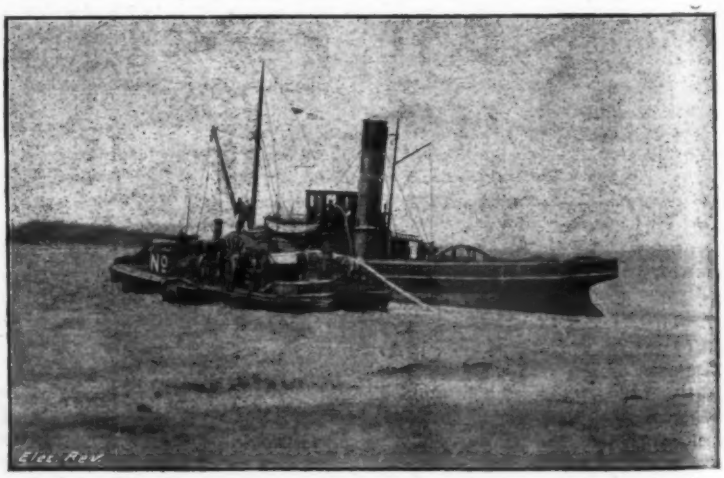


Fig. 2.—Cable-laying in Progress

Scholarship Examinations.—The examinations for Science Scholarships and Whitworth Scholarships will be held on April 30th—May 10th, 1924.

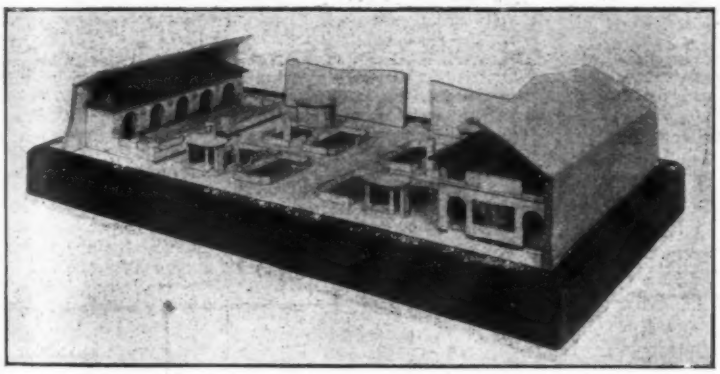
The Electrical Exhibits at Wembley.

In the ELECTRICAL REVIEW for June 1st, 1923, we published alphabetical lists of the electrical and other engineering firms and companies which up to that date had booked space in the B.E.A.M.A. and B.E.A. Sections of the British Empire Exhibition. We have now received a copy of an official pamphlet in which are given lists of all exhibitors in the United Kingdom section. In this section are included:—

The Palace of Engineering, comprising the exhibits organised by the British Electrical and Allied Manufacturers' Association, the British Engineers' Association, the Land Transport class (General Land and Factory Transport, Railway Transport, Motor and Cycle and water transport).

The Palace of Industry, comprising boots and shoes; the gas industries' co-operative exhibit; building materials and metal work, strong-rooms, heating, lighting, and ventilation; chemical industries, dyestuffs, and perfumery; cotton textiles; domestic utilities and fancy goods; food products and beverages; jewellery and clocks, &c.; lace, leather; miscellaneous textiles; music trades; paper, printing, stationery, &c.; pottery and glass; rubber industries; scientific instruments and photography; silk; sports, games, and toys; tobacco; Yorkshire and Lancashire wool and allied textiles.

Exhibits in the grounds, including the horticultural section.



Photograph of Model of the E.D.A. Exhibit.

Since our list of electrical and engineering exhibitors was published there have been a number of additions to which we shall refer shortly.

It remains to be added that these amplified lists are practically complete, as only a few names can be added between now and the opening of the Exhibition.

The E.D.A. Exhibit.

We have already made somewhat full reference to the Palace of Electricity wherein will be made the great display which is being organised by the British Electrical Development Association. In the accompanying illustration we give a photographic view of a model, to scale, of the E.D.A. Section, which will be the rendezvous of supporting associations. It depicts a number of central stands and kiosks and a part of the Electric House or bungalow, which is the principal building.

The bungalow, which will be situate at the north end of the section, will be so arranged with ample gangway accommodation as to permit large numbers of people to pass through without congestion, viewing as they walk innumerable practical applications of electricity for domestic use. At the south end of the section there will be the Bureau and Rendezvous of the contributing electricity supply undertakings, where the representatives of these concerns will afford those interested any information and accommodation that may be needed. In the central part of the structure there will be eight large open stands. The four principal corners will be covered by raised kiosks in which various electrical operations will be carried out by attendants, against suitable backgrounds and under powerful spot lighting. The object of this feature is to produce a series of "living posters," changing from time to time and likely to prove attractive and helpful in arresting the attention of visitors passing through this part of the exhibition. The open stands will be occupied by a full range of domestic, small industrial, business and special electrical appliances, so amplifying the display in the house and presenting in an orderly sequence everything that is practicable for use to-day.

As we have already stated, the fund necessary for this display is being provided by electricity supply authorities and the Associations representing various sections of the industry. It is intended that the lighting of the E.D.A. section, which will be carried out under the auspices, and with the help, of the Electric Lamp Manufacturers' Association shall be in every way notable and worthy of the importance of the occasion. The extensive cable and wiring system required to provide for the thousands of different electrical applications in this section will be arranged for by the Cable Makers' Association, who will also exhibit an interesting display of modern methods of wiring.

The complicated task of carrying out the installation to the requirements of the Electric Supply Committee in control of the section is being undertaken by the Electrical Contractors' Association, whilst the apparatus needed, and representing many thousands of pounds in value, is placed at the disposal of the Committee for the duration of the Exhibition, by members of the British Electrical and Allied Manufacturers' Association.

The display will in the aggregate be equivalent to dozens of first-class electrical showrooms, and it will be placed in a situation where it will in the course of six months be inspected by many millions of people.

In addition to the main E.D.A. Section, it has been arranged to take a small space in the ground near H.M. Government Building, and to make a display of the uses of electricity on the farm and in agricultural work. This will be arranged for and on behalf of the E.D.A. by Mr. R. Borlase Matthews.

Alkali Vapour Detector Valves.—In the January *Journal* of the A.I.E.E. Prof. C. T. Knipp and Mr. H. A. Brown, both of the University of Illinois, describe the unusual and very desirable results that are obtained by priming tungsten-filament three-electrode valves with an alloy of potassium and sodium when such valves are used as detectors of radio-frequency currents in receiving circuits. The advantages claimed are: lower optimum plate voltage (from 5 to 10 volts); less critical adjustment of plate voltage; steady action; considerably greater sensitiveness to weak signals than that of gas content valves; and no distortion in detector action. The sensitiveness at low plate voltages of valves containing potassium-sodium alloy vapour, and probably other alkali metal vapours, is due to the low ionising potentials and probably also to other characteristics, such as photo-sensitivity, contact potential, &c., of such vapours. The tubes need no frequent adjustments of filament current or plate voltages, but the electrode spacings must be small to obtain the low plate-voltage characteristics. Curves and measurements show excellent amplifier characteristics, especially at higher filament temperatures, and the effect of residual gas on the detector and amplifier characteristics is nullified by raising the filament temperature from 10 to 15 per cent. For sensitive detector operation the filament temperature necessary to make the alkali vapour active is a little lower than the rated value for that type of tube. Dr. Jakob Kunz recommended the alkali metal vapours in response to an inquiry as to what gases possessed the lowest ionising potentials.

F

A New Centrifugal Oil Purifier.

The Empson All-British Machine.

THE maintenance of lubricating, and also transformer, switch, and other insulating oils in an efficient state has for long presented difficulties. For example, the separation of water cannot be completely effected by standing and decantation; further, the decantation method will not deal with the fine solids in suspension, and, though subsequent passage through a filter will improve the condition of the oil, it will not remove them entirely. In use, therefore, the oil rapidly becomes loaded with impurities, and ultimately reaches such a condition as to render its further use unsafe.

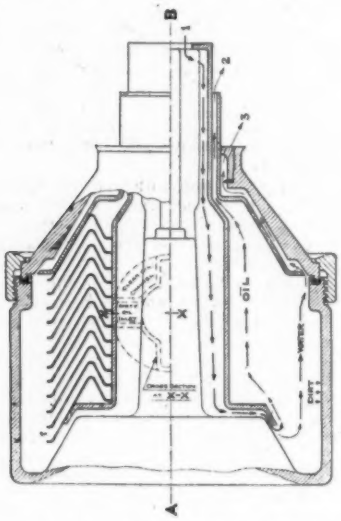


Fig. 1.—Section of Purifier Drum.

It is an accepted fact that a good mineral oil loses none of its basic properties through continued use, and, provided the impurities can be removed, its efficiency can be maintained indefinitely. Centrifugal treatment is claimed to furnish a complete solution of the above-mentioned difficulties, as it removes all traces of sludge, carbon, metal particles, water, &c., maintaining the lubricant at the highest possible efficiency, while obviating the losses hitherto incurred. To effect separation it is essential that there should be a difference in the specific gravities of the liquids and solids to be dealt with, but, as the centrifugal force applied is so enormously greater than the force of gravitation, the necessary difference is so slight as to be undeterminable by actual measurement, and the separation is definite and complete.

Research having indicated that considerable advantage might be secured by washing dirty hydrocarbon oils with water, provided they could afterwards be thoroughly dehydrated, a centrifugal oil purifier has been so designed as to carry out the two processes continuously in the revolving drum.

The achievement of this object by Empson Centrifugals, Ltd., has involved very radical departures from previous practice, and the results obtained in every-day operation have, we are assured, fully confirmed laboratory experiments. Thus, no matter whether the dirty oil be wet or dry, it is purposely mixed with water upon its entrance into the drum of the machine, and yet after passing between the cones it is perfectly dehydrated.

The drum, illustrated in section in fig. 1, is made of high tensile steel and contains a removable centre tube upon which are assembled a number of cones of special shape. The cones are accurately die-stamped from sheet aluminium, their shape ensuring greater rigidity and mechanical strength than is possible with plain cones, and also conducing to the efficiency of separation. Owing to their lightness and the accuracy of their manufacture, they may be assembled upon the central tube promiscuously without interfering in any way with the balance of the drum.

The action of the drum may be best appreciated by considering the half section to the right of the line A—B, with cones omitted, as a gravity settling tank, from which it will be seen that pouring water into inlet 1 will constitute a water seal, the level rising to that of the lowest overflow 3.

If oil containing water and dirt be then poured through the inlet 1, a certain amount of water will be displaced, and the entering dirty oil will pass round the under-side of the left-hand baffle, the dirt settling on the bottom of the tank and the oil rising upwards through the water seal and being discharged through the outlet 2. The action of the revolving drum follows the same principle, but the centrifugal force effects instantaneous separation, whereas the action of gravity would be slow and by no means complete.

Fig. 2.—Empson Centrifugal Oil Purifier.

Fig. 3.—An Electrically-driven Model.

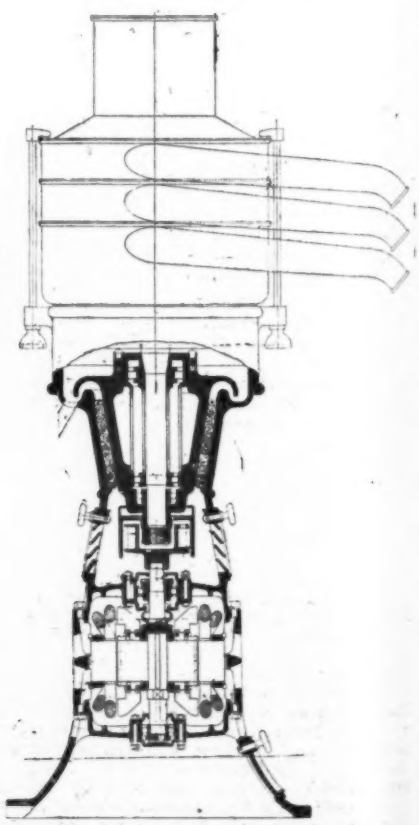


Fig. 4.—Section of 3-phase Machine.

Each of the orifices 1, 2, and 3, is surrounded by a tier of tinware with a separate spout, the lower one discharging only water, the middle one purified oil, while the top spout only comes into action when sufficient dirt has accumulated in the drum and choked the entrance, thus showing that the machine requires cleaning out, an operation which takes only a few minutes.

Each drum is provided with rings for regulating the water-spilling diameter to suit oils of various specific gravities,

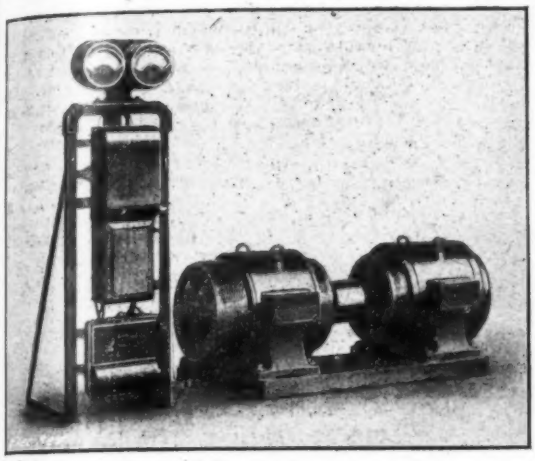


Fig. 5.—A Frequency Changer.

and they are easily changed by unscrewing the ring nut at the orifice No. 3, as shown in the diagram. The drum-cover joint is made in the same manner in all sizes of machines, viz., by means of a rectangular section rubber ring embedded in a groove in the body of the drum, being thus perfectly secured against displacement when tightening up.

The washing action referred to above is of great importance in dealing with transformer oils, as any fibres in the incoming oil are thoroughly saturated with water and, their weight being in consequence increased, they are driven to the walls of the drum, together with the dirt. This applies even to fibres of microscopic proportions, and it is not at all uncommon to find a clotted mass like cotton waste in the drum after treating oil which previously showed no trace to the naked eye. The elimination of such fibres renders the oil much less susceptible to the effects of moisture, and we are informed that remarkably consistent readings are obtained when testing its dielectric strength.

The washing action also results in the removal of colloidal carbon, which has hitherto defied centrifugal force unless previously assisted by chemical treatment, and it need hardly be added that acidity is amenable to the same action.

As an example of performance it is stated that extremely dirty oils breaking down at 2 or 3 kV can be raised to 50 or 60 kV B.E.S.A. standard by one passage through the machine. In demonstrating the purification of lubricating oil, frequent use is made of the dielectric strength test as the measure of moisture content, and motor crank-case oil has been raised to 24 kV B.E.S.A. standard, whereas before treatment its break-down voltage was so low that no reading could be obtained with the instrument available.

The remaining portions of the machine, which is British-made throughout, have been equally carefully designed; ball and roller bearings are employed to reduce driving losses, and automatic clutches are fitted to secure easy starting. The machines are provided in four principal sizes, ranging in capacity from 50 to 350 gallons per hour, and arranged for either belt or electric drive.

While the purifier may be fitted with fast and loose pulleys for belt drive, fig. 2 shows an electrically-driven machine of 50 gallons per hour capacity in which the motor is incorporated in the frame and drives the drum through an automatic clutch and a single train of gearing.

Probably the ideal drive for such centrifugal machines is that illustrated in figs. 3 and 4, which show a high-speed 3-phase motor of special design built into the frame directly in line with the drum spindle, which it drives through a clutch, the speed being 6,500 r.p.m. Such motors requiring higher frequencies than are normally met with, a frequency changer (fig. 5) is employed to drive a group of purifiers, and in power stations where three or four machines can be installed the total cost is somewhat less than that of an equal number of the ordinary type. Oil purifiers of the type described are also being supplied as portable plant, complete with driving motors, heaters, pumps, and switchgear.

The Physical Society of London.

ANNUAL EXHIBITION OF INSTRUMENTS.

(*Concluded from page* 152.)

Siemens Bros. & Co., Ltd.

This display consisted practically wholly of pyrometric equipment. An optical pyrometer was shown in operation. This instrument is suitable for the measurement of temperatures up to 2,400 deg. C. The heated object is observed through a telescope and its brightness is compared with that of a standardised electric lamp fitted inside the telescope. The temperature of the lamp varies with the current passed through it. This is measured by an ammeter and the corresponding temperature is read on a specially-calibrated scale. Ten-way and forty-way distance thermometer switchboards and indicators were exhibited. In the former the switches are arranged in a circle, and are of the push-button type. They are interlocked, rendering it impossible for two thermometers to be switched on together. The outfit has been designed for use on board ship, *e.g.*, for measuring the temperatures of cold storage chambers, oil tanks, funnel casings, &c. The 40-way pattern is intended for use in cold stores, power stations, breweries, &c., and is similarly constructed.

H. Tinsley & Co.

A comprehensive display of standard condensers, bridges, resistances, galvanometers, and other scientific apparatus appeared on the firm's stand. A co-ordinate a.c. potentiometer which was shown consists of two potentiometers, one giving the e.m.f. in phase, and the other giving the e.m.f. in quadrature, thus supplying two separate components., which can be proportioned by dials so as to give any magnitude or phase. The exact quadrature between the two e.m.f.'s is determined by a mutual inductance, which also serves the purpose of comparing the e.m.f. in phase with that in quadrature. The absolute value of the e.m.f.'s is fixed by means of a reflecting dynamometer in one potentiometer circuit, which is standardised upon direct current. When the two e.m.f.'s are adjusted in quadrature the unknown e.m.f. is measured across a portion of each of these e.m.f.'s as the vector sum of the two components. The latest form of ionisation potentiometer was shown. The instrument is now made with an enclosed circular slide wire. This slide wire is not assumed to be proportional throughout its length; its divisions are accurately calibrated point by point and the scale is engraved to correspond. The range of the instrument is from 0.0001 to 1.8 V, and special types have been made with a range of from 0.00001 to 1.8 V. Another exhibit was a phonic chronoscope. In this a tuning-fork-operated motor drives a disk at a uniform speed. Upon the reception of an electrical impulse a small wheel is brought into contact with the disk and is removed when the impulse ceases. By this means intervals of time down to a few thousandths of a second can be indicated. Another tuning-fork (or phonic) device was an apparatus for controlling the speed of a machine. Two phonic motors are employed to operate the field rheostat. One motor is controlled by a tuning fork, and the other from the machine which is being governed. When the two phonic motors are running in synchronism the field rheostat is unaltered. When a change in speed occurs the rheostat is moved until synchronism is restored.

A. Gallenkamp & Co., Ltd.

In addition to small laboratory electric furnaces—tube furnaces, muffles, organic combustion furnaces, &c.—this company showed an electrometric titration apparatus. This comprises a stand carrying burettes, calomel and hydrogen electrodes, a beaker on a rising table support, a reservoir for KCl solution, a variable-speed friction-driven stirrer and electric motor, and an oak cabinet containing measuring instruments. The equipment can be used for hydrogen ion concentration measurements or the preparation of accurately neutral or buffer solutions.

The Damard Lacquer Co., Ltd.

The feature of this company's exhibit was a collection of finished products made of "Formite" by its customers, showing what beautiful results can be obtained with this

material. The electrical part of the exhibit consisted of a variety of "Formite" insulating materials, comprising Bakelite cements, enamel, varnishes, moulding powders, &c., and the "Damarda" acid-resisting lacquers for scientific instruments.

George Kent, Ltd.

Messrs. George Kent, Ltd., showed their coal meter, boiler load indicator, curved tube manometer, and other instruments for use in the boiler-house. A new feature was an automatic device for cutting off the supply of steam to boiling vats, so as to maintain the water at boiling point without boiling over. This instrument depends upon the use of a metal alloy which melts at the desired temperature. Initially a piston rests upon the solid alloy at the bottom of a tube immersed in the water in the vat; the steam valve being opened, the water is heated until the alloy melts, allowing the piston to descend until an adjustable stop prevents further motion, closing a butterfly valve to a degree which permits only sufficient steam to pass to keep the water "on the boil." Kent's "balance manometer" was also shown, a device for measuring and recording the flows passing through orifices, or other differential pressure producing devices. The curved-tube manometer is an accurate indicator of the rate of flow of air or gas in conjunction with a Venturi or Pitot tube, or an orifice; the fact that the flow varies as the square root of the pressure difference cramps the scale of an ordinary straight-tube manometer at low flows, but by suitably curving the tube, so that the lower end is nearly horizontal, an almost uniform scale over a wide range is obtained, and accurate readings can be made down to about 1-15th of the maximum rate of flow.

R. & J. Beck, Ltd.

Together with a variety of microscopes, photomicrographic apparatus, &c., was shown the Lewbeck projection micrometer for the rapid measurement of wires and fibres to 1/50,000th of an inch.

Ross, Ltd.

This firm showed, *inter alia*, its standard kinematograph projector, and the Ross high-intensity searchlight arc lamp. Difficulties have been experienced in adapting the searchlight-type of arc (with a mirror) to the kinematograph projector, mainly due to the excessive heat concentrated on the gate aperture and uneven distribution of light, but with the Ross lamp, taking 60 to 70 amperes, it is claimed that excellent illumination over the whole of the screen is obtained without greater heat in the gate aperture than with the ordinary 60-ampere arc and condenser.

C. Baker.

Microscopes in great variety were shown, including a Brinell impression microscope reading to 0.01 mm., photomicrographic apparatus, &c.

The Sigma Instrument Co.

This firm showed calorimeters, thermostats, &c., of non-electrical types, also an electric relay for thermostats, and the Whetham commutator for the measurement of the electrical resistance of liquids.

Watson & Sons (Electro-medical), Ltd.

A large exhibit of electro-medical apparatus included a high-pressure, oil-immersed transformer for spectroscopic investigations with X-rays, having an output of 2 kVA continuously at 60,000 V; a new pattern of oil-immersed induction coil, arranged vertically, giving 90,000 (peak) volts continuously; and a variety of Coolidge X-ray tubes. One of the tubes, with a water-cooled molybdenum target, operates continuously at 30 A, 35,000 to 40,000 V (r.m.s.). A similar tube, but not water-cooled, was shown and a "deep therapy" tube for use at 200,000 volts for intensive X-ray treatment.

Darimont Electric Batteries, Ltd.

The exhibit of this firm consisted of a varied assortment of cells of the Darimont type, in which two liquids are used, separated by a porous pot, in the pores of which a semi-permeable membrane is formed, which prevents diffusion. The excitants, known as "Hemiporogene" and "Radiogene," have as their chief constituents sodium chloride and ferric chloride, the electrodes being of zinc and carbon. In operation the cell is inodorous, gives a constant current at an e.m.f. (open-circuit) of from 1.3 to 1.5 volts, and is easily recharged. An illustrated account of the cell appeared in the ELECTRICAL REVIEW of November 2nd, 1923. It should be particularly useful in connection with radio telephony, especially in conjunction with the new low-current valves, but perhaps its most important application will be to railway track signalling and to commercial telegraphy and telephony. A new standard size, measuring 5¼ x 10¼ x 9 in., and having an internal resistance of 0.15 to 0.175 ohm, with a capacity of 145-150 Ah, was shown. Such a cell would operate a ½-ampere valve two hours a day for nearly a year, after which it could be recharged for a few shillings.

The Record Electrical Co., Ltd.

This company showed a complete range of "Cirscale" instruments, with deflections up to 300 deg., without gearing, including fixed and portable patterns and a series of miniature precision instruments 3 in. in diameter and 5¼ in. long. A new feature was a moving-iron "Cirscale," invented by Mr. J. W. Record, which for alternating current takes the place of the well-known d.c. moving-coil instrument. This device, which was shown in model form last year, has two moving irons acting "in series," with separate coils, which are connected in opposition, rendering the system nearly astatic. As shown in the accompanying fig. 13, a pointer deflection of 330 degrees is obtained, the deflections being very open at the beginning of the scale. Damping is effected with an air dash-pot, and we understand that the temperature and frequency errors are negligible. To obtain so large a deflection with this type of instrument is a notable achievement.

Another interesting item was a portable ammeter-voltmeter with five ranges of volts (5 to 750) and six of amperes (1 to 600), for alternating current. Such instruments have, of course, been available for d.c., but it is claimed that this is

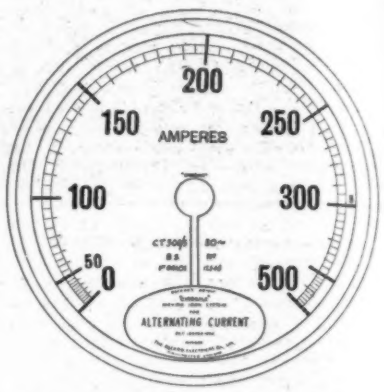


Fig. 13.—Dial of Moving-iron "Cirscale" a.c. Ammeter.

the first successful attempt to overcome the difficulties met with in connection with alternating current. It depends upon Mr. Record's patent "change-coil system." A moving-iron movement is used, with a coil which, instead of being, as usual, a fixture, can readily be replaced by another of a different current capacity. By this means any desired range, whether of current or pressure, can be obtained; moreover, the instrument is suitable for use also with direct current, and can be tested for accuracy with d.c. The coils are fitted with the instrument in a convenient carrying case.

Finally, reference must be made to the new ohmmeter and generator that was exhibited. This weighs 6 lb., and measures 7¾ x 4¾ x 5¼ in. In general it is similar in appearance to the company's earlier model, and it is fitted with the "Record" improved handle for driving the generator. By the use of cobalt steel magnets for the generator and ohmmeter lightness and compactness are secured, and other improvements have been introduced into the instrument.

H. G. Pye & Co.

A variety of electrical measuring instruments of the reflecting and of the indicating type was shown at this stand, including equipment suitable for laboratories. The firm is the sole maker of the X-ray spectrometer of Prof. W. H. Bragg and Mr. W. L. Bragg, for studying the structure of crystals—a very fine instrument, by which this new weapon of science is brought within the reach of any skilled researcher.

Negretti & Zambra.

This firm had a varied display of meteorological instruments, pyrometers, thermometers, &c., amongst these being a distant indicating pyrometer with base-metal thermo-couples, giving readings from 23 test points. A recording resistance pyrometer was also shown.

Other Exhibitors.

Among other exhibitors the following may be mentioned: The Concordia Electric Wire Co., Ltd. (bare and insulated wires, flexibles, resistance wires and strips, &c.); the Edison Swan Electric Co., Ltd. ("Pointolite" lamps of from 30 to 4,000 c.p.); Foster Instrument Co. (thermo-couples, pyrometer equipment, milliammeters and millivoltmeters); Herbert Kennedy & Co., Ltd. (the "Elverson" oscilloscope); the M.O. Valve Co., Ltd. (thermionic valves, including "dull-emitter" patterns); Ross, Ltd. (kinematograph projectors); Weston Electrical Instrument Co., Ltd. (laboratory standard instruments, portable testing instruments, galvanometers, &c.); and the Zenith Manufacturing Co. (Wheatstone bridges, fixed and adjustable resistances, &c.).

Business Notes.

Bankruptcy Proceedings.—PERCIVAL BUTLER, trading as the Eastern Electrical Engineering Co., 11, Row 116, late 127, King Street, both Great Yarmouth, electrical engineer.—The public examination of this debtor was held on January 22nd at the Town Hall, Great Yarmouth. The statement of affairs showed liabilities of £157, and there was a deficiency of £153. Debtor stated that he commenced business in 1921, when he was out of employment, taking a shop at Yarmouth and entering into an informal partnership with another, who provided no capital. The partner had since gone away. Debtor attributed his failure to bad debts, lack of money, and robbery. The examination was closed.

THOMAS GEORGE HARLING WILEY, trading as Wiley & Co., Bradford Road, Stanningley, Yorkshire, late Cemetery Road, Pudsey, and Oxford Place, Stanningley, electrical engineer.—The first meeting of the creditors of the above was held recently at the Official Receiver's office, 12, Duke Street, Bradford. The statement of affairs showed liabilities of £269, against assets of £20, thus leaving a deficiency of £248. The case being a summary one, was left with the Official Receiver as trustee of the estate.

D. ROSE & CO. (Meyer David Rosenbloom, trading as), electrical engineers and factors, 25, Osborn Street, London, E.—The first meeting of creditors was held on January 24th at the London Bankruptcy Court. Mr. D. Williams, Official Receiver, reported that it appeared from the debtor's statements that he was born in Russia and had not been naturalised in this country, in which he had been resident 25 years. He had been in business during the past 20 years in the neighbourhood of Whitechapel, and although he traded as "D. Rose & Co." he had no partner. No statement of affairs had been lodged, but the debtor roughly estimated his liabilities at £3,000 due to 50 creditors, and returned in the shape of assets, stock-in-trade, expected to realise £500; fixtures, £20; and book debts, £600, to realise £300. The household furniture, valued at £100, was claimed by the debtor's wife, and all the assets were in the hands of the trustee under the deed of assignment. A policy on the debtor's life was also claimed by his wife as being her separate property. The debtor attributed his failure and insolvency to the action of the head landlord in obtaining an order of ejectment against him. The Chairman asked the debtor how that could be seeing that he was obviously insolvent before that step was taken, and in reply the debtor said if he had not been pressed by creditors and had been allowed to carry on he could have realised the assets at sufficient to pay all debts in full. His stock, which he now expected to yield only £500, had cost £2,250. In the statement of affairs submitted at the private meeting of creditors he valued it at £1,500, but that was for realisation in the ordinary course of business, and £500 represented the sum he expected it to fetch "under the hammer." The Chairman said he failed to see why stock which cost £2,250 should only be expected to realise £1,500 by ordinary trading, but the debtor offered no satisfactory explanation of the puzzle. A solicitor appearing for the Condor Lamp Co., creditors for £330, said his clients and some half-a-dozen of the other principal creditors had not received notice of that meeting. The Chairman said the debtor had supplied a list of the principal creditors and the notices were sent out to all firms appearing on the list. If any substantial number of creditors had been omitted it would be open to them to requisition a new meeting. The solicitor said the creditors in question were not prejudiced because they saw the notice in the *Gazette*, but it would be interesting to know why their names had not been supplied to the Official Receiver. The debtor, questioned on the point, said the list was supplied by the trustee under the deed of assignment. A resolution was passed for Mr. E. H. Hawkins, I.A., 4, Charterhouse Square, E.C., to act as trustee and administer the estate in bankruptcy, assisted by the following committee of inspection, *viz.*: representatives of the Condor Lamp Co., Marconi Co., and Lagendorf Watch Co. The fidelity bond to be given by the trustee was fixed at £800.

HENRY PICKFORD GALT, 56, Norbury Road, Thornton Heath, Surrey, electrical engineer.—The public examination of this debtor was held on January 23rd at the County Court, Scarbrook Road, Croydon. The liabilities amount to £333 and the assets to £17, or a deficiency of £316. The debtor stated that he started business in November, 1918, with a capital of £100, but that in June, 1921, he was in financial difficulties and was unable to meet his liabilities. He arranged with his creditors to pay a composition of 5s. in the £. When he started business he took over the premises on the mortgage value of £250 and property had now increased in value. The owner of the adjoining premises obtained an injunction and costs against him for trespass and damages regarding the removal of a fence and a right of way, and when execution was levied for £242 the debtor was compelled to file his petition. The examination was adjourned. The following are creditors:

	£		£
British Thomson-Houston Co., Ltd.	48	General Electric Co., Ltd.	14
F. H. Boys	11	H. W. Easter	242

HORACE BOOCOCK, Whackhouse Lane, Yeadon, lately trading as Hardwick & Co., 28, New Lane, Selby, Yorkshire, electrician.—The receiving order in this matter was made on debtor's own petition. The statement of affairs shows liabilities of £544, against assets of £56. The first meeting of the creditors was held recently at the Official Receiver's office, 24, Bond Street, Leeds, when the case, being a summary one, was left with the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
C. Bywater	11	H. Mitchell	21
D. Boocock	23	Osborne & Co., Ltd.	17
Concordia Wire Co., Ltd.	17	Russell & Co., Ltd.	73
Electrical Specialities Co., Ltd.	15	L. Rigg	12
Bankers	30	S. Yeadon	53

J. H. RIGBY, electrician, 22, Higher Hillgate, Stockport.—Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester, released January 15th, 1924.

W. E. WEEKS, wholesale electric dealer, 59, Victoria Street, Bristol.—Last day for proofs for dividend, February 5th. Trustee, Mr. J. P. Emett, 18, Nicholas Street, Bristol.

F. A. WATKINS, electrical engineer, 57, High Street, Hythe.—Supplemental dividend of 3d. in the £, payable at 4, Charterhouse Square, E.C.1.

H. RHODES (Victoria Electrical Co.), kinema operator, Victoria Buildings, Keswick.—First meeting February 5th; public examination February 5th, at the Court House, Warrington.

V. G. BURKITT (V. G. Burkitt & Co.), electrical engineer, 38, Park Row, Bristol.—Application for discharge to be heard February 29th, at the Guildhall, Bristol.

B. T. DAY, electrical engineer, The Grove, Benton, Northumberland.—Trustee, Mr. W. Brittain, 4, Northumberland Street, Newcastle-on-Tyne, released December 15th, 1923. 1923.

P. C. LETHERBARROW (Letherbarrow Brothers), electrical contractor, 1, Church Lane, Banbury.—Last day for proofs for dividend, February 8th. Trustee, Mr. G. Mallam.

R. RUDD, electrical engineer, Long Ashton, Somerset.—Last day for proofs for dividend, February 8th. Trustee, Mr. W. F. Darley, Official Receiver, 26, Baldwin Street, Bristol.

THE FAIRLESS ENGINEERING SUPPLIES CO., LTD., of Stockton-on-Tees, says that as several years ago it was wrongly supposed that it was connected with the Engineering Supplies Co. (Newcastle-on-Tyne), which is now the subject of bankruptcy proceedings, it is anxious to make it clear that it was never at any time connected with the firm.

Company Liquidations.—HOLBORN RADIO CO., LTD.—Winding-up order made by the High Court on January 18th.

INDICATORS, LTD.—First meeting of creditors and contributories January 30th, at Carey Street, W.C.

STOCKPORT LAMP CO., LTD.—Particulars of claims to the liquidator, Mr. W. P. Masterson, Bank of England Chambers, Tib Lane, Manchester, by February 29th.

ELECTRIC TRACTION DEVELOPMENTS, LTD.—A meeting of members is called for February 28th, at Milburn House, Newcastle-on-Tyne, to hear an account of the winding-up by the liquidator, Mr. H. W. J. Vertigan.

CITY SCHOOL OF WIRELESS TELEGRAPHY, LTD.—A meeting of members is called for February 26th at the offices of Messrs. Bond & Son, Dickinson Street, Manchester, to hear an account of the winding-up from the liquidator, Mr. A. Lloyd.

Dissolution of Partnership.—THE LONDON ELECTRICAL AND MECHANICAL ENGINEERING CO., electrical and mechanical engineers, 163a, Lordship Lane, Wood Green.—Messrs. F. H. Daynes and C. R. E. Matthews have dissolved partnership.

Trade Announcements.—THE TEYNHAM ENGINEERING CO. has opened wireless showrooms at 20, East Street, Sittingbourne.

THE CENTRAL GARAGE AND WIRELESS CO. has opened new wireless showroom premises at 6, High Street, Ryde.

MESSRS. MOULDED PRODUCTS, LTD., have taken over a factory at Chester Road, Castle Bromwich, for the moulding of synthetic materials for electrical fittings and insulating purposes.

The name of Messrs. Bruce Peebles & Co.'s new agents for the West and North of Scotland is MESSRS. SELLAR, INGLIS AND CO., not Sellar, *Inglish* & Co., as given in our issue of January 18th.

Mr. G. M. STEVENSON, of 136, Yardley Wood Road, Moseley, Birmingham, is not now representing Messrs. T. W. Broadbent, Ltd., of Huddersfield, in Birmingham, and he has commenced business on his own account as an electrical contractor. Messrs. Broadbent ask that all communications from Birmingham and district should be addressed to them at their head offices, Victoria Electrical Works, East Parade, Huddersfield.

MESSRS. LORD & SHAND, LTD., electrical and mechanical engineers, are shortly removing from Buckland House, Millbay, Plymouth, to Union Street, Plymouth.

In the report of the hearing of an Old Bailey charge, published in our issue of last week, mention was made of the fact that the defendant Davis had said that he had carried on

business as the Enterprising Engineering Co. The Enterprise Manufacturing Co., Ltd., asks us to mention that it was in no way connected with that concern.

Catalogues and Lists.—PIGGOTT ELECTRICAL CO., LTD., 24, New Bridge Street, London, E.C.4.—Price card relating to cables, bell wire and inspection tube fittings.

STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, London, W.1.—Illustrated and descriptive price lists: No. 363a, dealing with gramophone record and voice amplifying outfits; and No. 389, relating to the "Anodion" two-valve long-range receiving set.

Mr. P. PRATT, 66, Victoria Street, London, S.W.1.—Stock-taking list of fuses, lightning arresters, and various accessories.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., 170, Piccadilly, London, W.1.—Catalogue No. 106, describing the Duff Barrett automatic lowering jack, for which the company has been appointed sole selling agents in Europe and the British Colonies; second edition of an electric tool catalogue (No. 12E); circular No. 89, devoted to the Little Giant hammer drill; and circular No. 90, dealing with the C.P. rock drills.

THE IMPERIAL ENGINEERING CO., Electric House, Grape Street, Shaftesbury Avenue, London, W.C.2.—Illustrated and priced card relating to the Imperial electric irons.

THE WALSALL ELECTRICAL CO., LTD., 57, Bridge Street, Walsall.—Leaflet showing the company's generator and battery panels.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—New descriptive lists as follows, well illustrated and in the company's standard style, have been issued:—No. 6500-B, dealing with flow meters for steam, water, oil, air or gas; Price List No. 5650 (sections one and two) dealing with d.c. automatic control equipment for non-reversing motors and for reversing motors; Price List No. 5644-A, dealing with float and tappet switches; and Price List No. 5100-C, devoted to hand-operated d.c. starting rheostats.

MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, S.W.12.—Two illustrated and priced leaflets, VR7, describing a new product—the one-volt Ora valve—and MW4, dealing with the Wecovalve, including its characteristic curve. More complete data is given, and the curves have been drawn with smaller squares to enable more accurate readings to be taken.

MESSRS. STEEL BELT CONVEYORS, LTD., Norwich Union Chambers, Birmingham.—Fully descriptive and well illustrated booklet relating to their steel belt conveyor—a band conveyor with a flexible linkless metal band—of which there are 1,500 installations in Great Britain, Scandinavia, Europe, the Colonies, and the U.S.A., handling a wide variety of materials. Copies of the publication will be sent to engineers and manufacturers on application.

THE LONDON FACTORS AND AGENTS, LTD., 38 and 39, Parliament Street, London, S.W.1.—New price list of various electrical accessories and supplies. The company has signed the fair-trading clauses of the E.C.A., and the list is subject to trade discounts.

MESSRS. H. W. SULLIVAN, LTD., Winchester House, London, E.C.2.—New illustrated and priced catalogue (72 pp.) of wireless components for receiving and transmitting sets.

MESSRS. CHAS. CLIFFORD & SON, LTD., Fazeley Street Mills, Birmingham.—New pamphlet of 24 pages, containing a number of tables likely to be of use and interest to merchants, engineers, and others connected with the metal trades.

THE GEAR GRINDING CO., LTD., Handsworth, Birmingham.—Twenty-eight-page pamphlet by Mr. H. F. L. Orcutt relating to motor-car gear-box design and production, with special reference to gear tooth grinding.

MESSRS. L. G. HAWKINS & CO., LTD., 116, Charing Cross Road, London, W.C.2.—Illustrated and priced sheet giving particulars of their "Duplexalite" scientific lighting unit.

MESSRS. NATHAN & ALLEN, LTD., 25, Victoria Street, London, S.W.—Illustrated and priced descriptive lists: No. 44e, relating to h.p. time switches and remote control switches, 3,300 and 6,600 volts; and No. 45Ae, devoted to low-pressure automatic electric time switches.

Calendar.—MESSRS. MCWHIRTER & SONS, LTD., of Wharf Street, Cardiff, have sent us a wall calendar with daily date slips. A photograph is given of the company's winding and machine shop.

Japanese Reconstruction.—We have received further communications from Tokio and Osaka intimating the receipt of a number of copies of the ELECTRICAL REVIEW special circulation dispatched for the information of Japanese engineers, traders, and others interested in the work of reconstruction.

The Electrical Industry in China.—On p. 74 of our issue for January 11th, 1924, we reproduced from the *Hamburger Nachrichten* certain notes on the electrical industry of China. Our attention has now been called to the fact that the review in question first appeared in the journal of the *Deutscher Wirtschaftsdienst G.m.b.H.* (Berlin), who inform us that our notes are a true translation of the original. We are equally pleased to make this acknowledgment and to have the accuracy of our reproduction thus substantiated.

Exhibition Award.—MESSRS. GRIFFITHS BROS. & CO. LONDON, LTD., have been awarded the Gold Medal for their insulating varnishes shown at the Exhibition held in Brazil in 1923.

Social Events.—As many as 400 children and friends of the employés of Messrs. J. H. Tucker & Co. were present at the Christmas festival recently held in the works canteen at Tyseley, Birmingham. The decorations were excellent, and there were three electrically-illuminated and well-laden Christmas trees. After tea there was a musical and ventriloquial entertainment. During the evening Mr. J. B. Tucker and Mr. S. R. Davies addressed the children. The arrangements were carried out by a management committee, assisted by the whole of the Executive Committee of Tucker's Athletic and Recreation Club, and the works canteen staff were responsible for the catering.

The staff of the Siemens and English Electric Lamp Co., Ltd., in Upper Thames Street, E.C., held a concert and social on the premises on Friday last, January 25th. An "Unmusical menu in 20 courses, entitled 'Yes, we have No——?'" was rendered, and a dance followed.

Book Notices.—"Science Abstracts" A and B. Vol. XXVI. Part 12. No. 312. December 25th, 1923. London: E. & F. N. Spon, Ltd. Price 3s. each.

"Electric Supply Share Handbook," compiled by H. Blake. Pp. xv; figs. 136. London: Effingham Wilson. Price 5s. net.

Fowler's "Electrical Engineer's Pocket-book for 1924." Price 3s. net. Fowler's "Mechanical Engineer's Pocket-book for 1924." Price 3s. net. Fowler's "Mechanic's and Machinist's Pocket-book for 1924." Price 2s. net. Manchester: Scientific Publishing Co.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLIII. No. 1. January, 1924. New York: The Institute. $1.

"Kelly's Directory of the Electrical Industry, Wireless and Allied Trades Throughout England, Scotland, and Wales, &c." London: Kelly's Directories, Ltd. Price 30s.

The Danish Municipal Visit.—On Thursday, January 24th, a party of representatives of the municipality of Copenhagen, who are in this country studying problems in relation to gas and electricity supply, paid a visit to Birmingham. The deputation was received by the Lord Mayor (Ald. T. O. Williams), with whom were, among others, Mr. H. K. Beale (chairman of the Electric Supply Committee), and Mr. R. A. Chattock (electrical engineer). After a civic luncheon, the party visited the electricity supply works, features of which were fully explained by the officials. The party included Messrs. Peder Hedebol (member of the Danish Landsting and chairman of the Gas and Electric Supply Committee) and C. Hentzen (chief engineer of the electricity supply station, Copenhagen).

Local Exhibition.—BELFAST.—A unique and interesting electrical exhibition was opened in the Ulster Hall, Belfast, on January 23rd. It has been organised by Belfast electrical manufacturers and contractors to bring before the public the vast strides made in recent years in the application of electricity to heating, and cooking, and power.

For Sale.—Barrow-in-Furness Corporation Electricity Department has for disposal three Babcock & Wilcox boilers and three 125-h.p. Brush vertical compound engines, direct coupled to 75-kW, d.c. generators. Nelson Corporation Electricity Department invites offers for one 400-kW generating set. (See our advertisement pages to-day.)

Ediswan Contracts.—THE EDISON SWAN ELECTRIC CO., LTD., has received the following contracts:—

Booth Steamship Co.—Carbon, metal, and gasfilled lamps for 12 months.
Cunard Steamship Co.—Carbon, metal, and gasfilled lamps for 1924.
Canadian Pacific Ocean Services.—Ditto for 1924.
War Office.—Inert cells and dry cells.
Formby Council.—200 meters.

Fire at the Siemens Works in Berlin.—*The Times* Berlin correspondent reports that early on the morning of Saturday last a fire broke out in the electrical factory of Messrs. Siemens & Halske at Mariendorf, near Berlin, and destroyed a large part of the building with most of the running machinery. Firemen were much hampered by live electric wires. It is stated that 2,000 workmen are thrown out of employment.

Unemployment.—The number of persons on January 14th, 1924, recorded on the live registers of the Employment Exchanges in Great Britain was 1,220,400. This was 7,306 less than on January 7th, 1924, and 265,478 less than the figure recorded on January 1st, 1923. In addition, the number working systematic short-time and drawing benefit for intervals of unemployment was 52,600 on January 14th, 1924, as compared with 53,802 on January 7th, 1924, and 56,361 on January 1st, 1923.

Rumanian State Enterprises to be Commercialised.—*Reuter's* agent at Bucharest states that the Minister of Industry is engaged in drawing up a scheme for the commercialisation of State undertakings. It is laid down that no property belonging to the State may pass into the hands of foreigners, that the capital of these undertakings shall be found by the State, and that all undertakings so commercialised shall be controlled by a department under the control of the Minister of Finance. A limited liability company will be promoted and run by a board of directors. Railways and posts, and telegraphs and telephones will not fall under the control of the company. It is thought in Government circles that if the scheme is put through it will yield in the course of two years several hundred million lei, whereas at present there is a deficit.

Russian Electrical Notes.—The Russian Mint (Petrograd) is being reorganised and all its machinery is to be electrified.

The demand for current in Moscow, which increased considerably in 1922-23, has fallen away appreciably during the last few months, owing to the depressed conditions of industry and to the warm weather, which reduced the heating demand.

At the Baskakoff cable factory the Central Russian Electric Trust is completing the equipment for the production of wolfram filaments and molybdenum wire for electric lamps. The apparatus required for drawing the wolfram is partly made in Russia and partly abroad. It was hoped to put this plant to full work during January. The preparation of a special laboratory for extracting wolfram from its ore has been arranged for. The reserves of wolfram ore are sufficient, and measures are being taken to increase the production of molybdenum wire.

The Electric Planning Authority considered a report at its last sitting on the capacity of the Russian market for electric lamps. It was shown that in the year 1914 subscribers to public stations had 7,500,000 lamps; industry was using 5,000,000 lamps and the transport services 300,000 lamps, making a total of 12,800,000 lamps. In the year 1923-24 the public stations will install 10,900,000 lamps, transport 300,000 lamps, and industry 14,600,000 lamps. During the current year 8,200,000 lamps are expected to be replaced; and assuming the installation of 500,000 new lamps, there will be a total new supply to consumers of 8,700,000 lamps. In view of the limited capacity of the market expected during the ensuing five years, and the decline of the private factories, the report insists on the prohibition of the importation of lamps into the Republic. The Planning Authority, however, awaits more details.

The Electrotrust, says a note from Kazan, is offering electricity meters to working people at 25 gold roubles, payable in instalments of 5 r. per month, instead of hiring them out.

British Trade with Canada.—The *Vancouver Sun* for December 17th stated: "Unless British manufacturers take immediate steps to capture the Western Canadian market by establishing branches and distributing agencies right on the ground, the coolness towards British products which has been engendered by the refusal of the British electorate to give Canadian goods a tariff preference is going to drive another 50 per cent. of Canada's import business straight into the United States. Right or wrong, the sentiment of Canadian consumers to-day is not friendly towards the people of Britain. Canadian buyers feel that the idea of empire has been much more strongly stressed on this side of the water than in Britain, and that a nation too selfish to consider anything else but its own immediate needs can be left, without compunction, to find its own trade markets. Prejudiced or not, this is Canadian sentiment to-day. The onus of establishing better trading relations with the Dominion rests now, almost entirely, on British manufacturers themselves. And the only way they can enlarge their markets in this direction is to prove their confidence in the country by spending their money here."

Electric Dining Car Equipment.—About two years ago the Jackson Electric Stove Co., Ltd., installed their electric dining car equipment on one of the G.N.R. trains. It has acquitted itself so satisfactorily that an order for five more equipments to be installed on the new dining car expresses now in course of construction by the London and North-Eastern Railway, has been placed with the company.

A **Big Dock Contract.**—A number of British firms tendered for the Avonmouth Dock extension at Bristol, and Messrs. Sir William Arrol & Co. have secured the contract at £554,000.

Swedish Industries.—We have received a copy of a substantially bound volume bearing the title, "Industrial Sweden." It is a work published by the General Swedish Export Association in connection with the Gothenburg Jubilee Exhibition, 1923. It contains articles relating to the more important export industries, such as iron and steel, timber, woodpulp, paper, chemicals, engineering, and electrical industries. The main part of the book is devoted to short descriptions of a large number of industrial concerns, and contains information concerning productive capacity, trade marks, agents, &c. We understand that a few copies of the volume are available, and application therefor should be made to the office of the Swedish Consul-General in London, 329, High Holborn, London, W.C.1.

Copper and Lead Prices, &c.—Messrs. F. Smith & Co. report, January 28th: Copper (electrolytic) bars, £68 10s., 15s. increase; ditto ditto, sheets, no change; ditto ditto, wire rods, £78 10s., 15s. increase; ditto ditto, h.c. wire, 9 13-16, 1-16d. increase.

Messrs. James & Shakespeare report, January 29th: Copper bar, sheet and rod, £95, £2 increase; English pig lead, £33 5s., 5s. decrease.

Messrs. C. Clifford & Son, Ltd., report, January 28th: Babbitt's metal and anti-friction metal, Grade I, £229, £10 increase; Grade II, £164. £8 increase; Grade III, £89, £3 increase.

Lighting and Power Notes.

Aberdeen.—OPPOSITION TO ORDER.—A petition is to be lodged by the Town Council against the granting of an Order applied for by the Grampian Electricity Supply Co. It is stated that the proposed Order would enable the company to supply electricity in an area to which the Corporation already has authority to give a supply.

Ashton-under-Lyne.—ELECTRICITY SUPPLY.—With a view to effecting economies in the distribution of electrical energy, particularly during the night, the South-East Lancashire Electricity Board has drafted a scheme in connection with the supply in Ashton. It is suggested by the Board that either Manchester or Oldham should supply the current during the night to the Ashton area. Manchester Corporation, however, insists that Ashton should pay for the whole of the energy transmitted to the borough, whereas the Oldham Corporation has expressed its willingness to charge only for the actual amount of energy used. At a recent meeting of the Limehurst Urban District Council, a letter was read from the Electricity Board inviting the local Council's opinion on the matter. In view of the fact, however, that the Council had already decided to support the Ashton Corporation's Parliamentary Bill for powers to supply electricity in the rural district, the clerk was instructed to notify that the Council should exclusively negotiate with Ashton on any business of the character indicated.

Australia.—ELECTRICAL DEVELOPMENT.—The first portion of the Yallourn power station is expected to be brought into operation during the autumn, by which time the transmission line to the Yarraville station, Melbourne, will be completed.

The South-Western District Scheme of the Victorian State Commission is nearing completion. The scheme provides for a transmission line from Geelong, through Winchelsea, Colac, Camperdown and Terang to the port of Warrnambool, a distance of 117 miles.

Barnsley.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £31,590 for extensions to the electricity works. Of this sum, £28,500 is for new plant.

Bexley.—ELECTRICITY IN BULK.—In connection with the bulk supply from Woolwich, the Urban District Council has amended its application to the Electricity Commissioners reducing the estimated capital expenditure for sub-station and main transmission cables from £35,600 to £28,500, and the estimated capital expenditure on feeder and distribution cables from £8,786 to £8,767.

Bradford.—BREAKDOWN.—A generator at the Valley Road works broke down on January 22nd, and the whole of the electricity supply in the town was cut off for 30 minutes.

Ceylon.—HYDRO-ELECTRIC DEVELOPMENT.—The Ceylon Legislative Council on January 24th adopted the hydro-electric scheme for Ceylon, involving a capital outlay on the first stage of over ten million rupees.—*Reuter's Trade Service* (Bombay).

Continental.—GERMANY.—A *Reuter* dispatch dated Cologne, January 20th, states that in anticipation of the threatened strike at the Fortuna power station, which supplies Cologne with electricity, the British authorities requisitioned the necessary labour to maintain this essential public service. Disobedience to this order brought the workers within the jurisdiction of the British Summary Court. The step did not involve interference in the conferences and quarrels of the disputants, but was intended solely for the safety of the general public and the maintenance of order. The dispute centres partly round wages and chiefly round working hours, there being opposition towards a restoration of the ten-hour day. Six hundred other workers were requisitioned to ensure the supply of "brown" coal to the Goldenberg works, which supplies electricity to the British and Belgian zones. The strike was spreading rapidly, seven mines belonging to the Rhenish-Westphalian electricity concern being idle. Six hundred workers were requisitioned to take over the Rhenish-Westphalian power station on January 22nd, following the failure of attempts to settle the strike. This works supplies electrical energy for the entire district between the Dutch frontier and the Ahr Valley, aggregating 400,000 kW. Of this amount, the Goldenberg works supply 190,000 kW.

ITALY.—Approval has been given by the Italian Supreme Council of Public Works to a concession to utilise the waters of the upper Adige in the Trentino for generating electricity. A company has been organised by the cities of Merano and Bolzano to construct a large hydro-electric station, and it is reported that work will be begun immediately.

Egham.—ELECTRICITY SUPPLY.—At a recent meeting of the Urban District Council, the Lighting Committee reported that the Electricity Commissioners had forwarded notice of an application by the Egham and Staines Electricity Co., Ltd., for powers to supply electricity to the Ascot District Gas and Electricity Co. A new cable is to be laid, to be available for the Wentworth Estate, now being developed by Tarrant, Ltd.

Epsom.—ELECTRICITY ORDER.—The Urban District Council is applying to the Electricity Commissioners for a Fringe Order authorising it to supply electricity in the parish of Ewell.

Exeter.—NEW PLANT.—The Electricity Committee has recommended to the Town Council that application be made to the Electricity Commissioners for sanction to extend the generating plant at the electricity works by the installation of a turbo-generator of from 1,500 kW to 3,000 kW capacity.

Hatfield.—ELECTRICITY SUPPLY.—At a recent meeting of the Rural District Council, Major W. J. King applied for consent to an application to the Electricity Commissioners for a Special Order authorising him to supply electricity in the parishes of South and North Mimms. The clerk stated that application was being made to charge 1s. per kWh, and he had joined with the Herts County Council in filing an objection. He added that a letter had been received from the North Metropolitan Electric Power Supply Co., which had authority to supply the district at 10d. per kWh, and pending the application of Major King, the company was not willing to take further steps at present. It was decided to negotiate with the company with a view to entering into an agreement to supply electricity at an early date in the areas at Little Heath and Northaw.

Hemel Hempstead.—ELECTRICITY SUPPLY.—The Rural District Council has decided to offer no objection to the application of the Luton Town Council for an Order to supply electricity to the parishes of Markyate and Flamstead.

Invergordon.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £10,000 in connection with the electricity scheme.

Knaresborough.—ELECTRICITY SUPPLY.—The Urban District Council has taken a canvass of residents to ascertain the probable demand for electricity. In the meantime, the Council is negotiating with the Harrogate Corporation with a view to obtaining a supply of electricity at a charge not exceeding 7d. per kWh for lighting, and from 2½d. to 3d. per kWh for power.

Littleborough.—LOAN SANCTIONED.—The Urban District Council has received the sanction of the Electricity Commissioners to the borrowing of £11,000 for electricity purposes.

Liverpool.—ELECTRICITY FOR THE DOCKS.—The Mersey Dock and Harbour Board, at a meeting on January 24th, decided to instruct the engineer to proceed with the following work: The installation of an electric power and lighting system throughout the southern part of the Liverpool dock estate, from the Herculaneum Dock to the Canning Dock, at an estimated cost of £220,891. The Unemployment Grants Committee is prepared to make a grant towards the cost of the scheme.

Llandrindod Wells.—NEW PLANT.—The Urban District Council has decided to install an oil engine at the electricity works at an estimated cost of £1,000.

London.—ST. PANCRAS.—The Electricity Committee has recommended that, subject to the consent of the Electricity Commissioners being obtained, an additional 1,500-kW motor converter be installed at King's Road power station at an estimated cost of £6,000, and three 1,500-kW motor converters at the Regent's Park station at an estimated cost of £22,400. When the converter has been installed at King's Road, one of the existing 1,000-kW sets is to be transferred to the Highgate Road sub-station.

ELECTRICITY CHARGES.—On January 24th the City of London Court of Common Council decided to petition the Electricity Commissioners to review the power given to the Charing Cross, West End, and City Electricity Supply Co. Ltd., in 1920 to raise its maximum price from 5d. to 8d. per kWh.

STOKE NEWINGTON.—The Borough Council has decided to carry out extensions to the electricity works at a cost of £31,000.

New Zealand.—ARAPUNI SCHEME.—The scheme for the electrification of the North Island is to be put in hand immediately. The construction of the works at Arapuni is recommended as the first part of the scheme.

Northampton.—SPECIAL ORDER.—The Northampton Electric Light & Power Co. has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include the borough of Daventry, the urban districts of Wolverton, Newport Pagnell and Bletchley, the rural districts of Pottersbury and Newport Pagnell, and certain parishes in the rural districts of Brixworth, Northampton, Daventry, Towcester and Hardingstone.

Northern Ireland.—DUBLIN.—At a recent meeting of the Corporation it was proposed that the special committee appointed to take charge of the Liffey water-power scheme be authorised to take all necessary steps for the promotion of a Private Bill on behalf of the Corporation for the utilisation of the water power of the river Liffey for the purpose of generating electricity, and to enable the Council to oppose any private Bills or applications for Orders which might be introduced by other promoters involving the utilisation of the Liffey water power.

Poole.—ELECTRICITY SUPPLY.—The Bournemouth & Poole Electricity Supply Co. has applied to the Rural District Council for consent to an application to the Electricity Commissioners for an Order to supply electricity in the Council's area. The Order is to replace the one obtained in 1905, which was cancelled. The Council has decided to ask the company for further particulars of its scheme.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

LLANDRINDOD WELLS.—Power: Reduced to 6d. per kWh, making a reduction of 4d. per kWh within the past six months.

BECKENHAM.—Lighting: From 6½d. to 6d. per kWh.

CARDIFF.—Lighting: Flat rate, from 5½d. to 5d. per kWh; maximum demand rate, from 5½d. per kWh for the first 1,000 kWh to 5d.; prepayment charges, from 6½d. to 6d. per kWh. Heating and cooking: winter quarters, from 1½d. to 1½d. per kWh; summer quarters, from 1½d. to 1d. per kWh.

Radcliffe (Lancs.).—ELECTRICITY EXTENSIONS.—The Electricity Committee has had under consideration alternative schemes for obtaining an improved electricity supply in the northern part of the area beyond Black Lane Station. The Council has now decided to erect a mercury rectifier sub-station adjoining Black Lane Station, and to extend the Council's e.h.p. supply.

Tetbury.—SPECIAL ORDER.—The Western Electric Distributing Corporation, Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity within the urban district of Tetbury and certain parishes in the rural district of Tetbury.

Thornton. — ELECTRICITY SUPPLY. — The Urban District Council has appointed a deputation to meet the Blackpool Electricity Committee on the question of a supply of electricity for the district.

Truro.—ELECTRICITY AGREEMENT.—The Electricity Commissioners have approved of the agreement between the Town Council and the Cornwall Electric Power Co. for a supply of electricity.

Wolverton.—PROPOSED ELECTRICITY SUPPLY.—The Aylesbury Town Council has asked the Urban District Council whether it is committed to any scheme for an electricity supply, and whether it would be favourably disposed to consider an electricity supply for the district. The Urban Council has replied that at present there is no electricity supply, and that it is not in a position to consider the matter further at the present time. It has also been decided to ask the L.M. & S. Railway Co. whether it would be willing to undertake the electric lighting of the town, as the Council is unwilling to commit itself to any other undertaking before knowing what is the attitude of the railway company in the matter.

Wye (Kent).—ORDER REVOKED.—The Ministry of Transport has revoked the Special Order granted to the Wye Lighting, Heating and Power Co., Ltd., to supply electricity in the district.

Tramway and Railway Notes.

Bradford.—RAILLESS TRACTION.—The tramway general manager (Mr. R. H. Wilkinson), in a private report to the members of the Tramways Committee, definitely recommends the gradual change-over from tramways to the railless system, on the ground of saving in cost of renewals, but he admits that the change will have to be slow owing to the inadvisability of scrapping existing good tramway equipment. Conversion is advocated on certain routes as they fall due for renewal. Owing to the hills on many Bradford routes, and the liability of double-decked railless cars to skid, single-deck vehicles for these gradients are recommended at present. The highest cost in conversion is that of road reinstatement, but once done it is finished with, whereas there is continual expenditure on permanent-way maintenance if tramways are continued. Mr. Wilkinson puts forward the Lidget Green, Manchester Road to Odsal, and Duckworth Lane to the junction of Haworth and Bingley Roads, as suitable routes for railless traction. Powers to run railless cars are being sought for all routes. The manager has been instructed to obtain six more one-man railless trolley cars.

Croydon.—RAILLESS TRACTION.—Forty-three polling stations were open for 12 hours at Croydon on January 24th to enable 80,000 electors to vote for or against Part IV of a Parliamentary Bill promoted by the Borough Council. Under the Bill the Council seeks powers to introduce railless tramcars on the present Addiscombe route, with extensions beyond the present system; to regulate queues of tramway passengers; and to link up with the L.C.C. system so that tramcars can run from Purley to the London termini. Under the part of the Bill voted on, the Council seeks sanction to run motor 'buses, by which, in the summer time, the Addington Hills would be made accessible.—*Evening News.*

The electors voted in favour of the proposals.

Halifax.—LOSS ON FARES INNOVATION.—The sale of books of tram tickets at fourteen penny tickets for one shilling, which was inaugurated last October with the object of inducing a more extended use of the cars, is reported to be involving a loss of £70 a week. The electricity and tramway managers are to report on the whole subject of tram fares.

Hastings.—SERVICE RESTRICTED.—In order to conserve supplies of coal, the tramway services were suspended on Sunday (January 27th) and restricted during the following week.

Keighley.—RAILLESS CARS.—At the Town Hall, on January 18th, a conference was held between representatives of the Town Council and of the West Riding County Council with regard to the Corporation's intention to substitute railless cars for the present tramway service. Assistance towards the cost of the scheme is promised by the Ministry of Transport. An agreement is stated to have been come to between the representatives, subject to confirmation by the two Councils. If the

agreement is ratified, it is understood the County Council will withdraw its objection to the Keighley Corporation securing sanction to the change of systems.

London.—L.C.C. TRAMWAYS BILL.—It is understood that the scheme for running tramways to the Crystal Palace, which is included in the L.C.C. Tramways Bill, will not be pressed this session at any rate. The proposed route is partly in the borough of Lambeth and partly in Camberwell. Under the Standing Orders the consent of the local authorities through whose districts the tramways will run must be obtained, or, if more than one authority is concerned, consent as to two-thirds of the route is sufficient. Lambeth has consented, but Camberwell has refused, and the length of route in Lambeth is short of two-thirds by three chains.—*The Times.*

PROPOSED NEW TUBE.—At a recent meeting of the Lambeth Council, a resolution was passed suggesting the construction of a new underground railway circular route to embrace the following districts:—Kennington, Brixton, Streatham, Norbury, Thornton Heath, Croydon, South Norwood, Penge, Crystal Place, and Camberwell. The support of the Camberwell, Wandsworth, Croydon and Penge Councils to the scheme is being sought, and the resolution urges the London Electric Railway Companies to seek powers in the Parliamentary Session of 1925 for the extension of tube facilities for South and South-East London by means of a loop tube.—*Westminster Gazette.*

STATION ILLUMINATION.—Experiments on the tube railways with a view to reducing the congestion at important interchange stations have proved that doubling the illumination of the platforms results in a speeding-up of the traffic.

London, Midland & Scottish Railway.—Following a conference on January 15th between representatives of the L.M. and S. Railway and the Wallasey Corporation, a statement was issued to the effect that the electrification of the whole of the Wirral railway system will be undertaken as soon as the company's engineering staff has completed work now in hand. On behalf of the Wallasey Corporation, an assurance was given that it will be able to supply the necessary current when it is required.

Manchester.—PROPOSED TRAMWAY EXTENSIONS.—A poll of the ratepayers is to be taken upon the clauses in a Parliamentary Bill defeated at a town's meeting last week. These clauses seek power to run cars up and down Portland Street instead of up only as at present; also along Peter Street to Deansgate.

Southend-on-Sea.—LOAN.—The Town Council is applying to the Ministry of Transport for sanction to a loan of £33,250 for the purchase of six double-deck tramcars, &c. The sum applied for includes £4,250 excess expenditure in connection with the purchase of 13 double-deck cars.

Telegraph and Telephone Notes.

Argentina.—NEW RADIO STATION.—The Trans-Radio International Co.'s high-power radio station at Monte Grande, near Buenos Aires, was opened on January 25th. The company represents British, French, German, and American radio interests.—*The Times.*

The object of the Transradio Internacional Compania Radiotelegrafica Argentina is to place the Argentine in direct radio communication with North America, Europe, and the Far East. The transmitting station at Monte Grande, 20 kilometres from Buenos Aires, covers an area of 1,200 acres. There are ten steel towers 500 metres apart, each tower being 820 ft. high. The power of the station is 800 kW. The receiving centre is at Villa Eliza, 39 kilometres from Buenos Aires, and the same distance from the transmitting station. The telegraph office, from which the transmitting station is automatically controlled and to which the receiving station is connected by telegraph lines and an automatic linking device, as is the case in the Marconi system in this country, is situated in the centre of the commercial quarter of Buenos Aires.

Australia.—LONG-DISTANCE TELEPHONY.—With the opening of the Brisbane-Sydney telephone line in October, the third stage in the proposed circuit to connect Brisbane, Queensland, with Perth, West Australia, was completed. Plans are now being made for the construction of a line between Perth and Adelaide, which it is claimed will be one of the longest telephone circuits in the world. The charge for a three-minute conversation between Melbourne and Brisbane has been fixed at ten shillings. Traffic is so heavy at present on the Melbourne-Sydney lines that it is proposed to construct four additional lines. Two more lines are also to be established between Melbourne and Adelaide.—*Commerce Reports.*

Chile.—GERMAN RADIO STATIONS.—Our special correspondent informs us that an application has been made to the Chilean Government by the Siemens Schuckert Co., of Germany, to install a system of radio stations in the Chilean Republic. The proposed stations would be of the Telefunken type and would cost $1,385,000 (gold) (1 gold dollar=18d.). The offer comprises the completion of 11 stations in the course of 15 months, to be located as follows:—5-kW stations at Iquique, Antofagasta, Valparaiso, Santiago, and Punta Arenas; 2-kW stations at Calderá and Valdivia; and 4½-kW stations at Tocopilla, Taltál, Coquimbo, and Ancud. There is every probability that the offer will be accepted, an intimation to this effect having already been made by the Minister of the Interior. At present all radio stations in the Republic are of the Marconi type, operated and controlled by the Chilean Naval Department. Public disapproval has already been expressed of the change-over from the British to the German type, but in view of the fact that the Chilean Ministry is so frequently changed before projected plans can be carried into effect, it is not improbable that the concession asked for by the Siemens-Schuckert Co. may be deferred, or, if granted, subsequently cancelled.

Greenland.—RADIO STATION.—It is proposed to construct a radio station in Greenland, and the Danish Ministry of Finance and the Ministry for Home Affairs are considering the estimates at the present time. Two offers are said to have been received from a Danish firm and a German company (Telefunken) respectively for the establishment of the station. It is computed that the station will involve an expenditure of 800,000 kronen, and it will be able to communicate with Thorshavn.

India.—IMPERIAL RADIO COMMUNICATION.—The Government has definitely decided to entrust India's link in the Imperial radio chain to private enterprise. The terms of application are being drafted and will be issued shortly. It is probable that applicants will be given about six months for the formulation of their tenders. As an experiment, a temporary licence is being given to the Marconi Co. to broadcast a news service from Calcutta. The scheme is limited to a period of three months and is expected to be started immediately.—*The Times.*

South American Cables.—GERMAN-BRITISH AGREEMENT.—According to *The Times*, an agreement has been reached between the German Cable Co. and the Eastern Telegraph Co. by which the latter's system will carry German overseas traffic to South America pending the completion of the new German cable connection between Emden and Vigo. For this purpose the Borkum cable, belonging to the German company, has been lengthened *via* Dumpton Gap to London in the one direction and to Emden in the other. The London end is to be linked up direct to the Eastern Co.'s system. The agreement is for a period of about three years, and has been made in order to renew certain parts of the cable which were left derelict when the German cables were appropriated by Great Britain and France in the early days of the war. The negotiations have been in progress over a year.

The Eastern Telegraph Co. has laid ten miles of cable to connect at Dumpton Gap with the land line which it rents from the British Post Office and which is used in connection with a Belgian cable. Through that line German traffic will therefore be put direct on to the systems of the Eastern and Western Telegraph Companies.

Radio Notes.

Australia.—RADIO-BROADCASTING. — If expectations are realised broadcasting will become an accomplished fact in Melbourne and Sydney within the next three or four months. The Postmaster-General has issued a licence to Messrs. Farmer & Co., of Sydney, for the erection and conduct of a broadcasting station in New South Wales. It is understood that this firm, in association with others, intends to establish broadcasting stations in other States. Application has been made for a broadcasting licence in respect of a station capable of transmitting matter all over Victoria. The broadcasting stations to be built by Amalgamated Wireless (Australasia), Ltd., will comprise two for Victoria and Tasmania, two for Sydney, and one each for Adelaide and Perth. Messrs. Farmer's Wireless Broadcasting Service, Ltd., were to have commenced operations last month. Their station is being erected at Northbridge, two miles from Sydney proper. The broadcasting regulations as adopted by the Government are somewhat extraordinary. Each listener will be required to subscribe to one broadcaster and his instrument will be "sealed," so that it can receive the programme of that particular station and no other. If he wishes to take advantage of two or more services he will be required to subscribe separately to them all. Again, the broadcasting companies are at liberty to charge whatever they like.

Further dissatisfaction has been caused among experimenters possessing transmitting licences by the receipt of a notification from the P.M.G.'s department stating that each has been allotted a specified short wave length. Manufacturers and suppliers of receiving apparatus are to be licensed, such dealers being required to sell only appropriate sets to licence holders. The licences will cost 10s. per annum where one station only is listened to, or 20s. where two or more are listened to, in addition to the fee payable to the broadcasting companies.

Northern Ireland.—BROADCASTING.—It is reported that a broadcasting station is to be established in Belfast within about three months' time.

Radio-Broadcasting. — A WOMEN'S COMMITTEE.—Doubt about what women most want to hear during the broadcast talks to them from 5 to 5.30 p.m. has led to a committee of women being appointed to consider it. The committee held its first sitting on January 9th at the British Broadcasting Co.'s office. The members are Lady Denman, chairman of the National Federation of Women's Institutes; Miss Margaret Bondfield, M.P.; Miss Lilian Braithwaite, the actress; Miss Violet Cambridge, of the Women's Amateur Athletic Association; Dr. Elizabeth Sloan Chesser; Mrs. Hardman Earle; Miss Evelyn Gates; and Mrs. Fitzgerald, who is in charge of the women's hour at the B.B.C.—*Daily Mail.*

F.B.I. COMMITTEE.—It is reported that the Federation of British Industries has appointed a committee to consider the best means of utilising radio broadcasting for commercial purposes.

It is also understood that advisory committees have been formed at Glasgow to assist the development of the religious and educational sides of the broadcasting service and that similar committee has been nominated by the Associated Chambers of Commerce to co-operate with the B.B.C.

RELAY STATIONS.—Suitable sites are being searched for on which to establish the Plymouth relay station and a similar station at Edinburgh, while others will be installed at early dates to serve the Leeds-Bradford area, Liverpool, Hull, and Dundee.—*Daily Chronicle.*

Mr. H. C. Head-Jenner has been appointed by the British Broadcasting Co. to take complete charge of the Sheffield relay station. It is hoped to get Sheffield connected to all the broadcasting stations and not to Birmingham alone, as is at present the case.

Spain.—BROADCASTING CONCESSION.—It is reported that a concession has been granted to a British concern for radio broadcasting throughout Spain and that a station is to be erected in Madrid.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Aberdeen.—February 18th. Electricity Department. Two water-tube boilers, with superheaters, economisers, draught fans, steel chimney, piping, and accessories. (January 25th.)

Australia.—SYDNEY.—March 5th. New South Wales Government Railways and Tramways. Ironclad switchgear for Prince Alfred, Meeks Road, and Hurstville sub-stations.*

MELBOURNE.—May 22nd. Commonwealth of Australia. Automatic common battery telephone equipment. Schedule, N.S.W. 74. (January 18th.)

Barking. — February 19th. Electricity Department. Feeder and distributor cables. (See this issue.)

Belgium.—February 27th. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply and laying of telephone cables and accessories (1) in the Carolorégienne district and at Chatelineau; and (2) at Blaton, Dinant, Dour, Peruwelz, Rœulx, Saint-Ghislain, and Tamines. Particulars (Cahier des Charges Special No. 765) for 7½ fr.

ANTWERP.—February 23rd. Administration of the Province of Antwerp. Electric power distribution system for the communes of Beersse, Herenthals, Gheel, Moll, Arendonck, Turnhout, Beerse, including h.p. lines, with accessories, and the equipment of transformer cabins.*

Bexley.—February 7th. Electricity and Tramways Department. Two groups of 700-kVA Scott-connected transformers; one 150-kVA single-phase transformer; two 300-kV rotary converters, complete with transformers and all accessories; e.h.p., h.p. and l.p. switchgear, cables and connections within the station. (January 18th.)

Bradford.—February 21st. Electricity Department. Five 2,500-kVA, 3-phase transformers; m.p., d.c. switchgear; 6,600-V armour-clad switchgear, &c. (See this issue.)

Carlisle.—February 15th. Electricity Department. Four water-tube boilers complete with stokers, &c.; electrically-operated overhead turbine-room crane; 6,000-kW turbo-alternator and condensing plant; switchgear. (January 18th.)

Douglas (Isle of Man).—February 4th. Education Authority. Heating and lighting installation at the secondary school for boys. (January 25th.)

Edinburgh.—February 11th. Electricity Supply Department. E.h.p. and l.p. switchgear for sub-stations. (January 25th.)

Halifax.—February 4th. Town Council. Electrician's work required in connection with the erection of 30 houses, Quarry House estate, for Town Council. Borough engineer, Crossley Street, Halifax.

Kettering. — February 4th. Electricity Department. 26 miles h.p., l.c., s.t. cable and nine miles l.p., l.c., s.t. cable, joint boxes, slabs, &c. (January 25th.)

London.—LONDON COUNTY COUNCIL.—February 11th. H.p. and l.p. switchgear, comprising h.p. switchgear with control panels and d.c. switch panels for 2,000-kW rotary converters. (January 18th.)

METROPOLITAN WATER BOARD.—February 13th. Six or 12 months' supply of electric lamps. Chief engineer, New River Head, 173, Rosebery Avenue, E.C.1.

H.M. OFFICE OF WORKS.—February 12th. Electrical accessories. (See this issue.)

February 15th. Electric light wire and cable. See this issue.)

Manchester.—February 4th. Electricity Committee. One locomotive jib crane and grab. (January 18th.)

February 12th. Tramways Committee. Permanent-way special trackwork. Mr. W. Mattinson, general manager, Corporation Tramways, 55, Piccadilly.

New Zealand.—WELLINGTON.—March 5th. Post and Telegraph Department. Supply of screwed bridle rings. (Ref. 12913/ED/EC/2).*

Norwich.—February 26th. Corporation. Works in connection with Thorpe power station:—Two 24-in. and one 3-in. electrically-driven centrifugal pumps; e.h.p. main switchgear, e.h.p. auxiliary switchgear, l.p. auxiliary switchgear; cable connections, &c.; overhead mono-rail telpher coal conveying plant; four steel-tube fuel economisers, two steel chimneys, and four electrically-driven suction draught fans. (January 25th.)

Portsmouth.—February 8th. Electric lighting installation at the Grammar School, for the Governors. The Clerk.

Salford.—February 11th. Electricity Department. Coal supplies for six months commencing March 1st, 1924. Particulars and form of tender from Borough Electrical Engineer, Frederick Road, Salford.

Sheffield.—February 4th. Tramways and Motor Department. 25 double-deck vestibule tramcar bodies, complete with trucks and electrical equipment. (January 18th.)

Sleaford.—February 6th. Electricity Department. Storage battery, 118 cells. (January 25th.)

South Africa.—MAFEKING.—February 29th. Municipal Council. Electricity generating plant.*

Stockport. — February 10th. Tramways Department. Overhead electrical equipment of new tramways in Kew Road and Eastbourne Road, Birkdale. (January 25th.)

Stoke-on-Trent.—February 13th. Electricity Department. H.p. single-phase ironclad switchgear, coal bunkers, conveying plant, e.h.p. ironclad switchgear, e.h.p. truck-type sub-station switchgear, and static transformers. (January 18th.) Constructional steelwork, &c. (January 25th.)

Tadcaster.—February 9th. Electric lighting installation, Infectious Diseases Hospital, Garforth. Mr. G. A. Brown, Clerk to the Council, Tadcaster.

Tiverton.—February 8th. Town Council. Buildings and plant in connection with the installation of an electricity supply in the town:—Power-house buildings; gas engines and generators; main l.p. switchboard; balancer-booster set; battery; hand-operated travelling crane; mains—underground and overhead. (January 18th.)

Warrington.—February 18th. Electricity Department. 12 months' supply of transformers. (See this issue.)

Windsor.—February 11th. Board of Guardians. Reconstruction of engineering services at the Institution, with electric lighting wiring and erection of electric motor. Mr. W. W. Nobbs, consulting engineer, 50, Fairhazel Gardens, London, N.W.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Brighton.—Town Council. Converting plant. According to the *Morning Post*, the tender of Messrs. Crompton & Co., Ltd., at £10,550, has been accepted.

Castleford.—The Urban District Council has accepted the tender of the Electrical Contracting and Motor Co. for installing electric lighting at the baths at £125.

Derby.—Midland Railway Co. Accepted:—
Gasfilled electric lamps for six months.—General Electric Co., Ltd.

Glasgow.—Electricity Committee. Recommended:—
Five 1,500-kW rotary converters for the sub-stations at Kinning Park, Virginia Street, and Parkhead, and one 1,000-kW rotary converter for Langside sub-station (£31,794).—British Thomson-Houston Co., Ltd.
Electric lighting of 52 houses being erected at Kelvindale (£271).—Mr. R. J. Sinclair.
Electric lighting and bell installation in connection with new buildings to be erected at Glasgow Cross (£892).—Johnston, Park & Co.
200-kW transformers (£909).—Ferranti, Ltd.

Health Committee. Accepted :—
Rewiring of boiler house at Ruchill Hospital and new distribution board.—Mr. Hugh M. Fulton.
Alteration of the electric lighting installation at Anderston Library.—Johnston, Park & Co.

Master of Works. Accepted :—
25-b.h.p. electric motor, with fittings (£169), for driving a stone breaker at Alexandra Parade depôt.—Fleming & Co.

Tramways Committee. Accepted :—
Magnetic brakes for cars.—Metropolitan-Vickers Electrical Co., Ltd.
Track shoes.—Metropolitan-Vickers Electrical Co., Ltd.
Air compressor for Bearsden sub-station.—Ingersoll Rand Co., Ltd.

Government Contracts.—The following Government contracts were placed during the month of December :—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Alternators, motors, and spares.—Small Electric Motors, Ltd.
Battery.—D.P. Battery Co., Ltd.
Turbo-driven bilge pumps.—W. H. Allen, Sons & Co., Ltd.
Supply and distributing boards.—General Electric Co., Ltd.
Electric crane.—S. Butler & Co., Ltd.
Electric welding plant.—A.I. Electric Welding Appliances Co.
Generating set.—Campbell Gas Engine Co., Ltd.
Motor generator electric arc welding sets, and spares.—Alloy Welding Processes, Ltd.
Plant for electrification of engines and pumps, &c.—English Electric Co., Ltd.
X-ray apparatus.—A. E. Dean, Newton & Wright, Ltd.

WAR OFFICE.

Electric cable.—W. T. Glover & Co., Ltd.
Electric cells.—Siemens Bros. & Co., Ltd.
Wireless valves.—A. C. Cossor, Ltd.; Edison-Swan Electric Co., Ltd.; General Electric Co., Ltd.; Mullard Radio Valve Co., Ltd.
Voltmeters and ammeters.—Park Royal Engineering Works, Ltd.
Wireless parts.—Douglas Motors, Ltd.; Marconi's Wireless Telegraph Co., Ltd.
Electric lighting installations.—Gosport : V. G. Middleton & Co., Ltd. St. Mary's Barracks, Chatham : G. E. Taylor & Co. Halifax : Yorkshire Electric Wiring and Motor Co., Ltd.

AIR MINISTRY.

Accumulators.—Chloride Electrical Storage Co., Ltd.; Peto & Radford, Ltd.
Ammeters.—Weston Electrical Instruments Co., Ltd.
Inert batteries.—General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.
Magnetos.—British Thomson-Houston Co., Ltd.
Receivers.—H. W. Sullivan, Ltd.; Western Electric Co., Ltd.
W./t. receivers.—H. W. Sullivan, Ltd.
Transmitters.—C. A. Carter & Co.
Transmitters and receivers.—Gambrell Bros., Ltd.
Valves.—Mullard Radio Valve Co., Ltd.
W./t. valves.—General Electric Co., Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L. M. Ericsson Manufacturing Co., Ltd.; General Electric Co., Ltd. (Peel-Conner Telephone Works); Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Testing, protective apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd. (Peel-Conner Telephone Works); Walters Electrical Manufacturing Co., Ltd.
Leclanché battery boxes.—Siemens Bros. & Co., Ltd.
Telegraph and telephone cable.—Enfield Cable Works, Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Western Electric Co., Ltd.
Compound.—W. H. Keys, Ltd.
Telephone cords.—Siemens Bros. & Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Doulton & Co., Ltd.; Ensor & Co., Ltd.; H. R. Mansfield, Ltd.; Oates & Green, Ltd.; J. Place and Sons, Ltd.; Robinson & Dowler, Ltd.; Stanley Bros., Ltd.; Sutton and Co. (Overseal), Ltd.; J. H. Turner & Lisney, Ltd.
Fibre ducts.—Key Engineering Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).
Copper wire.—Elliott's Metal Co., Ltd.; Enfield Cable Works, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).
Enamelled and flameproof wire.—International Electric Co., Ltd.
Telephone exchange equipment.—Cheetham Hill (Manchester), Derby : Western Electric Co., Ltd. Banque Belge pour L'Etranger : Relay Automatic Telephone Co., Ltd. Higher Broughton (Manchester) : British L. M. Ericsson Manufacturing Co., Ltd.; sub-contractors for batteries : Tudor Accumulator Co., Ltd.; for charging set : Crompton and Co., Ltd. Cheltenham : Automatic Telephone Manufacturing Co., Ltd.; sub-contractors for accumulators : Chloride Electrical Storage Co., Ltd.; for charging machine : Newton Bros. (Derby), Ltd.; for ringing machine : Crompton & Co., Ltd. Cleeve Hill (Gloucestershire) : Automatic Telephone Manufacturing Co., Ltd.; sub-contractors for accumulators : Chloride Electrical Storage Co., Ltd.; for charging machine : Newton Bros. (Derby), Ltd.
Telephone repeater station equipment.—Fenny Stratford, Leeds, Catterick : Western Electric Co., Ltd.
Wireless stations.—British West Indies : Radio Communication Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Wiring New Science Museum, South Kensington : Foote, Milne & Co., Ltd. Motor and compressor for the National Physical Laboratory : General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Electrical train staff instruments.—Railway Signal Co., Ltd.
Telegraph materials.—Automatic Telephone Manufacturing Co., Ltd.; Bullers, Ltd.
Telephone materials.—Siemens Bros. & Co., Ltd.
Welding plant.—Quasi-Arc Co., Ltd.
Copper wire, &c.—J. Wilkes, Son & Mapplebeck, Ltd.

London.—Messrs. Alloy Welding Processes, Ltd., have received from the British Admiralty a contract for two A. W. P. stationary motor-generator electric arc welding sets, each for two operators. The generators will be of the company's new self-stabilising transformer type.

PORT OF LONDON AUTHORITY.—Accepted :—
Gasfilled electric lamps for three months.—General Electric Co., Ltd.

Sheffield.—Tramways Committee. Accepted:—
800 tons of steel tramway rails.—Steel, Peach & Tozer, Ltd.

Whitwood.—Urban Council. Accepted:—
Installing electric lighting at new houses to be erected.—Mr. A. Clarkson.

Forthcoming Events.

Institute of Transport.—Monday, February 4th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.30 p.m. Paper on "Road Transport in Relation to the General Transport Problem of the Country," by Mr. R. J. Howley.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, February 4th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Storage Battery Troubles," to be opened by Mr. F. W. Crawter.

(Western Centre).—Monday, February 4th. At Bristol. Ordinary meeting.

(North-Midland Centre).—Tuesday, February 5th. At Leeds. Paper on "Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.

(Wireless Section).—Wednesday, February 6th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Atmospherics and Their Effect on Wireless Receivers," by Mr. E. B. Moullin.

(North-Western Centre).—Tuesday, February 5th. At the Engineers' Club, Manchester. At 7 p.m. Ordinary meeting.

(Dundee Sub-Centre).—Thursday, February 7th. At the University College, Dundee. At 7.30 p.m. Paper on "Power Factors," by Mr. R. K. Robertson.

(Scottish Centre).—Saturday, February 9th. At the Grosvenor Restaurant, Gordon Street, Glasgow. At 7 p.m. Smoking concert.

Paisley Association of Electrical Engineers.—Tuesday, February 5th. At 30, High Street, Paisley. At 7.30 p.m. Paper on "Thermionic Valves," by Mr. H. R. Heys.

Rontgen Society.—Tuesday, February 5th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 8.15 p.m. Ordinary meeting.

Electrical Society of Glasgow.—Tuesday, February 5th. At Glasgow. Paper on "How Best to Create a Demand for Electric Service," by Mr. R. Hardie.

Batti-Wallahs' Society.—Wednesday, February 6th. At the Hotel Cecil. At 12.30. Luncheon. Dr. S. Z. de Ferranti will be the chief guest.

Royal Institution of Great Britain.—Thursday, February 7th. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "The Crystalline Structure of Organic Substances," by Sir Wm. Bragg, F.R.S.

Liverpool Engineering Society.—Thursday, February 7th. At the Midland Hotel, Liverpool. At 7 p.m. Annual dinner.

Electro-Harmonic Society.—Friday, February 8th. At the Caxton Hall, Westminster, S.W. At 8 p.m. Ladies' night.

Physical Society of London.—Friday, February 8th. At the Imperial College of Science, South Kensington, S.W. Annual general meeting, &c.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of suppliers or manufacturers of :—

IMP auto-battery switch (marked H. & C.).
All wood electric light fittings for wholly insulated system.
Electric bottle-washing machines.
PEERLESS lamps.
HARRISON arc lamps.

Notes.

The Railway Strike.—The strike of members of the Associated Society of Locomotive Engineers and Firemen came to an end early on Tuesday morning, having lasted just over eight days.

Freemasonry.—At the regular meeting of the Kelvin Lodge, held at Mark Masons' Hall, London, on the 25th ult., the members and visitors enjoyed an interesting and instructive lecture on "Celestial and Terrestrial Symbolism," delivered by the Hon. Sir John Cockburn, K.C.M.G., who also holds high masonic rank in South Australia, for which colony he was for many years Agent-General in Great Britain. The meeting was attended by Sir Frederick Pollock, Bart., P.C., as well as by men well known in the electrical profession.

Mining-type Electrical Machinery.—Messrs. Bruce Peebles and Co., Ltd., have received a certificate and report regarding tests which were carried out by Prof. D. Hay in the mining department of the University of Sheffield on one of their standard d.c., totally-enclosed, 45-b.h.p., 875-r.p.m., 81.5A, 460-V motors designed for use in fiery mines. The casing of the motor was filled with the most explosive mixture of firedamp and air, and this mixture was ignited by a secondary discharge from an induction coil, whilst the motor (assembled as for use) was surrounded by a similar explosive mixture. Under these conditions of test, flame did not pass from the apparatus to the explosive atmosphere outside, which remained unignited, nor did the apparatus suffer damage due to the pressure developed within it. Although the tests only refer to one type of apparatus, they serve to indicate that the firm's machinery meets the Home Office requirements for operation in fiery mines.

Local Societies.—ELECTRICITY AT HALIFAX.—Mr. W. M. Rogerson, electrical engineer to the Halifax Corporation, recently addressed the local Rotary Club on the historical, technical, and financial aspects of the Halifax Corporation electricity undertaking, and mentioned that it was just thirty years since the Corporation works were inaugurated. He had no doubt that whatever might develop under the Aire and Calder Electricity District scheme, the Halifax generating station would be maintained for many years to come, owing to its economical plant.

ELECTRIC POWER.—Dr. C. C. Garrard (General Electric Co., Ltd.), while speaking on the subject of "Electric Power" at a meeting of the Vesey Club, Sutton Coldfield, recently, insisted that wholesale emigration, which was recommended because of the alleged over-population of this country, meant retrogression instead of progress, and a slowing down of municipal activity. An effective partial solution of the problem was offered by the electrical engineer. The application of power as an aid to the activities of mankind was the biggest civilising influence they possessed. By utilising mechanical power, man acquired time to think; his psychological side was given time to develop; cultural evolution was rendered possible.

The Electrical Conductivity of Copper Castings.—Dr. S. F. Barclay, in the course of a paper on "The Practical Value of Modern Non-ferrous Alloys," read at the January meeting of the Lancashire Branch of the Institution of British Foundrymen, held in Manchester, said there was now quite a big demand for copper castings for electrical work. The essential requirement was high conductivity, mechanical strength being usually of minor importance. The founder, said the author, should thus aim at securing sound castings with the highest possible electrical conductivity. A deoxidising agent should be employed, otherwise the castings would be honeycombed with small holes. Boron was possibly the best deoxidiser, in view of its effectiveness, and, at the same time, its small influence on conductivity. It was of vital importance that all impurities should be eliminated, as even very small amounts had an extraordinary effect in lowering the electrical conductivity, and electrolytic copper should in all cases be employed.

As showing the effect of impurities on the electrical conductivity of copper castings, Dr. Barclay furnished the following table:—

Added Element.	Conductivity. Per cent. of Matthiessen Standard.
Tin, 0.38 per cent.	73.0
Zinc, 0.35	73.4
Nickel, 0.19	79.0
Iron, 0.15	59.2
Manganese, 0.12	71.0
Silicon, 0.18	54.0
Chromium, 0.04	91.5
Phosphorus, 0.07	63.2
Aluminium, 0.08	84.1
Magnesium, 0.012	98.7
Magnesium, 0.024	94.0
Magnesium, 0.038	89.5
No addition	97.2

Another very important class of castings for electrical work, said Dr. Barclay, was the slip rings used on rotary converters and other alternating-current electrical machinery. The demand of the electrical designer was that the slip-ring temperature should be as low as possible. There were two tendencies at work causing heating—the passage of the current through the ring and the frictional loss between the ring and the brushes. The ideal material would thus have high conductivity and low frictional loss. So far no alloy had been produced combining these two qualities, and a compromise between the two had to be made.

If pure copper was used, said the author, the heating due to the flow of current was small, but that due to frictional loss was unduly great on account of the unsuitability of the soft metal to withstand abrasion. If, on the other hand, a nickel-copper alloy was used, the frictional loss could be reduced to a small value, but owing to the high resistance the heating caused by the flow of the current was unduly great. Phosphor-bronze was sometimes specified for this purpose, and it was important for the founder to see that it was very pure in order to ensure high electrical conductivity and that the phosphorus content did not exceed 0.05 per cent. in order to ensure that there was a minimum of the tin-phosphorus eutectic which would lead to undue resistance loss. Admiralty gunmetal was more frequently specified on account of its more favourable micro-structure. Lead should be eliminated altogether, the zinc should not exceed the 2 per cent. specified, and, preferably, should be reduced to 1½ per cent.

Cargo Ship Propulsion.—In a paper on the "Influence of Type of Propelling Machinery on the Running Costs of ships" that he recently read at Newcastle-upon-Tyne before the North-East Coast Institution of Engineers and Shipbuilders, Mr. W. G. A. Perring attempts to set out the various items that go to make up the running costs of a purely freight-earning, 9,220-ton, 10.75-knot vessel and to ascertain how they are affected by the type of propelling machinery. It is pointed out that initial costs are very hard to fix definitely because of the fluctuations of the market and the many varieties of the same type of machinery available. In the case of ships burning coal fuel the crew will necessarily be larger on account of the work involved in trimming and stoking. Again, the motor ship can be successfully run with less men than can the oil-fueled reciprocating or turbine-engined ship.

In all cases vessels with the water-tube boilers possess a slight superiority over the corresponding ones with Scotch boilers. This results entirely from the extra cargo carried due to the increased deadweight in the case of the ships fitted with water-tube boilers. The geared-turbine ships possess advantages over those with reciprocating engine, partly because of the increased deadweight and partly because of the saving of fuel effected by the adoption of turbine machinery. The turbo-electric is the least economical of the steam drives considered; this is solely on account of the higher fuel bills and first costs. The claims laid for the turbo-electric drive are its ability to steam at reduced speed with high efficiency; the easy speed control, giving the ship good manœuvring power; besides the flexibility of the drive, allowing more scope for economic lay-out of the machinery inside the ship. The advantage of possessing high steaming efficiency over a large range of speed is useful in only a few types of freight-earning vessels, and the author considers it very doubtful whether this quality alone would justify its adoption. The analysis shows that the coal-fired ship can compete successfully with the oil-burning ship provided that the price of coal is approximately half that of boiler oil. It would appear that for short trips it is more profitable to use oil, but in long (over 3,000 miles) ocean voyages, where large quantities of fuel are involved, the coal-burning ship becomes a better paying proposition, although suffering from the point of view of cargo deadweight in every type of steam machinery considered; of course, with reservation respecting fuel prices per ton. With boiler oil at 30s. a ton (the same price as that assumed for coal) the oil-fired ship is very much superior. It is only on extremely long voyages that the Diesel ship possesses any advantage over the steamship, mainly on account of the higher first costs, but the Diesel-electric, for voyages of 3,000 miles and upwards, shows a marked superiority over all other types of drive. Its advantage for the shorter voyages over the other motor ships is because of the lower fuel consumption assumed for the electrical auxiliaries while in port; for the longer voyages it is first cost alone that enables it to run more profitably.

The problem of obtaining the absolute "best" ship for any trade is next to impossible of solution. It depends so much on prices that are never fixed. No attempt has been made to draw any rigid conclusions, but the results have been presented in a manner that will help everybody to draw their own, the results being for a size of boat very commonly met with in practice. The comparison, of course, cannot be "stressed" to apply to passenger-carrying vessels which are usually considerably faster and work under entirely different conditions. The analysis, although showing no one particular type to be vastly superior, does show that certain boats can trade with more profit than others over any given route and justify a close investigation of "ship economics" when selecting the type of machinery for a new design.

Appointments Vacant.—Instrument draughtsman (40s. to 50s., plus bonus), for the Royal Aircraft Establishment, South Farnborough; mechanician (£400), for the Government of Nigeria Post and Telegraph Department; plumber-jointer, for Falkirk Corporation Electricity Works. (See our advertisement pages to-day.)

The Kelvin Centenary.—Lord Kelvin was born on June 26th, 1824, and arrangements are being made by a committee convened by the Royal Society to celebrate the centenary of his birth in a fitting manner. The committee is composed as follows:—

Sir Richard Glazebrook, K.C.B., F.R.S. (chairman).
Dr. F. O. Bower, F.R.S. (the Royal Society of Edinburgh).
Mr. W. R. Cooper, M.A. (the Physical Society).
Sir John Dewrance, K.B.E. (the Institution of Mechanical Engineers).
Mr. D. N. Dunlop (hon. secretary).
Mr. F. Gill, O.B.E. (the Institution of Electrical Engineers).
Sir Donald MacAlister, Bart. (Vice-Chancellor of Glasgow University).
Sir Charles Morgan (the Institution of Civil Engineers).
His Grace the Duke of Northumberland (the Institution of Naval Architects).
Dr. E. C. Pearce (Vice-Chancellor of Cambridge University).
Dr. Alexander Russell (the Institution of Electrical Engineers).
Mr. F. E. Smith, F.R.S. (the Royal Society).

A large number of Dominion, American, and foreign men of science and engineers will be attending conferences at the British Empire Exhibition at that time, and July 10th and 11th have been selected as convenient dates for the Kelvin Centenary Celebrations.

These will include a meeting for the receipt of addresses from delegates, at which Sir J. J. Thomson will deliver a memorial oration, and a dinner at which the Rt. Hon. Earl Balfour has kindly promised to preside.

There will also be an exhibition of Kelvin apparatus, and it is hoped to issue a memorial volume containing the addresses and speeches delivered, with some account of the apparatus exhibited.

It is hoped that the President and Council of the Royal Society will receive the delegates during the celebrations at the rooms of the Society in Burlington House.

The Rhenish-Westphalian System of Inter-Connection.—The recent strike in the Rhenish lignite district has been the means of directing fresh attention to the general question of electricity supply in the region of Rhenish-Westphalia, seeing that the failure to receive deliveries of this class of fuel temporarily caused a stoppage of generating plant at one of the stations where lignite is the source of power. The north-west of Germany, for the purpose of supply, may be said to be divided into two great districts. The eastern district consists essentially of Westphalia and the Siegerland, which are served by the Communal Electricity Union, while the western district is provided for by the R.W.E. (the Rhenish-Westphalia Electricity Works, which deals with the area from the Dutch frontier to the Ahr district. Each of these two big undertakings comprises a number of electricity works which, for the most part, are based upon pit coal, to a small extent upon water power, and to a considerable extent upon lignite in the lignite-producing region. The R.W.E., in which are included lignite works, is credited with having an output of 400,000 kW, which is yielded by the works of Essen, Wesel, Neuss, M. Gladbach, Goldenberg, Bruhl, Lennep, Schlenke, Reishotz, Krawinklerbrucke, Hammerstein, Wermelsgirchen, and Ibbenburen. Among these works the Goldenberg lignite station, with a capacity of 190,000 kW, is claimed by the Germans to be the largest steam station in the world, and the Reisholz station comes next, with 75,000 kW, and is based upon pit coal.

All these stations are embodied in a closely-meshed network, which not only connects them with consumers, but also with each other, so that it is possible at any time for any one works to come to the assistance of another and thus ensure a reliable service throughout the area served. During the period of troubles in the Ruhr, the Goldenberg station went to the relief of the Essen and Reisholz stations, based upon pit coal. On the other hand, the pit coal stations recently came to the aid of the Goldenberg station, when, owing to the strike of the lignite miners, the plant, including two turbo-generator sets, each of 50,000 kW, was almost completely at a standstill, whereas under normal circumstances this station supplies from 100,000 to 120,000 kW. Under these circumstances of mutual assistance, no serious danger has arisen of a complete cessation of supply to the consumers of the Goldenberg station, although the British military authorities at Cologne requisitioned labour for the lignite mines so as to ensure the restarting of the plant at this station.

How extensive is the use of electricity in Rhenish-Westphalia, more particularly for the power requirements of trade and industries, is shown by the fact that the total supply in this region is estimated at 1,300,000,000 kWh per annum from the public works alone. As the pits and the iron works are claimed each to produce a similar number of kWh per annum, the total for this area is reckoned at about 4,000,000,000 kWh per annum. These figures compare with 6,200,000,000 kWh, which represents the estimated aggregate annual supply from all the public supply works throughout Germany.

Bedford Science Exhibition.—An exhibition of more than usual interest, together with a conversazione, was held in the Bedford School on January 10th-12th. It was organised by the Bedford Physical and Radio Society, and was opened by the Duchess of Bedford. Engineering science was well represented, and there was an interesting collection of scientific apparatus; the industrial applications of X-rays and radiography were demonstrated, and a variety of electrical and other experiments were shown. Lectures were given by Dr. A. O. Rankine, of the Imperial College of Science, on "Atoms"; Sir Richard Gregory, F.R.A.S., on "The Worth of Science"; Capt. P. P. Eckersley, of the B.B.C., on "The Difficulties inherent in Broadcasting Technology"; and Mr. E. B. Wedmore, director of the Electrical Research Association, on "The Fourth Dimension." Amongst the exhibitors of apparatus were Messrs. W. G. Pye & Co., Ltd., Siemens Bros. & Co., Ltd., Watson & Sons (Electro-medical), Ltd., Igranic Electric Co., Ltd., Cambridge & Paul Instrument Co., Ltd., W. Gallenkamp & Co., Cryselco, Ltd., and the Foster Instrument Co.

The originator of the exhibition was Mr. R. S. Allen, M.I.E.E., of Messrs. W. H. Allen, Sons & Co. (president of the Society), and amongst those who took part in the arrangements were the Mayor (Ald. G. H. Barford), Mr. R. Carter (headmaster of Bedford School), Mr. R. W. L. Phillips, A.M.I.E.E. (borough electrical engineer), and Mr. P. H. S. Kempton, B.Sc. (hon. secretary). The exhibition was an unqualified success, and resulted in a substantial contribution to local charities.

Standardisation of Colliery Requisites.—We understand that at the request of the Mining Association of Great Britain, the British Engineering Standards Association has undertaken the standardisation of colliery requisites, and the progress of this work will undoubtedly be watched with keen interest by the country as a whole. A fully representative committee is being set up, under the chairmanship of Mr. Evan Williams, president of the Mining Association, which is contributing to the funds of the B.E.S.A. to enable this important work to be carried out on an adequate basis. Local committees are to be instituted in the various centres to study the details of the subject, and it is intended by this means to make the fullest use of practical knowledge—that knowledge which is so fully possessed by those in daily contact with the apparatus and equipment being studied from the point of view of standardisation. In order, too, that concrete results may be obtained without undue delay, the committees are to concentrate their attention on a limited number of the more important questions.

King's College Engineering Society.—The anniversary meeting of this Society will take place at the Institution of Mechanical Engineers on February 12th at 5.30 p.m. Vice-Admiral Sir George Goodwin, K.C.B., will deliver an address on "Economics as Applied to Mechanical Engineering." Sir John Dewrance, K.B.E., President of the Institution of Mechanical Engineers, will take the chair. The Society's dance will be held at the Hyde Park Hotel on February 1st at 9 p.m.

The Elkett Telephone Call Recorder.—Australian Inventions, Ltd., a company recently incorporated to assist in the protection and development of inventions, has, according to the Sydney *Evening News*, secured the world rights in respect of the Elkett telephone call recorder, which was recently demonstrated in Sydney. The device is said to consist of an "electrically-operated lock, which can be attached to any telephone at a trifling cost, and a key about the size of a large watch, which enables a given number of calls to be made at any telephone, public or private. The user would obtain his key from the postal department and would pay for it in advance. The key may provide for any number of calls from 100 to 1,000, and as each call is made it is registered on a dial. In this way no matter what telephone is used the call is registered against the user and not, as at present, against the owner of the telephone. When the total number of calls provided for had been used the key would cease to operate the lock attachment."

Inquests.—At an inquest at Sheffield last week on Joseph Howes, whose death was caused by a furnace rake which he was carrying over his shoulder at Messrs. Jonas & Colver's steel works, coming into contact with an overhead electric wire, Dr. A. W. Wilson said that death was due to shock causing paralysis of the heart. Witness said he had no previous experience of such a case and had no knowledge of the Home Office regulations applying thereto.

Mr. A. Wolfe, Inspector of Factories, who attended with Mr. H. W. Swann, H.M. Divisional Electrical Inspector of Factories, read extracts from the regulations to the effect that after rescue treatment should be commenced at once and continued for at least two hours.

John Henry Lowe, the electrician in charge at the works, said he examined the cable after the accident and found that it was about 7 ft. 6 in. from the ground. Normally it was about 9 ft. from the ground. The insulation was torn where the rake had touched it. The cable, which was fixed at a temporary extension about five months ago, carried 200-volt alternating current.

A verdict of "Accidental death" was returned.

A verdict of "Accidental death" from burns was returned at an inquest in Belfast into the death of David Lindsay, who was injured by an unexplained flash while working near a generator in the Corporation electricity station on January 9th.

Institution Notes.

Institution of Electrical Engineers.—INFORMAL MEETING.—At the meeting of the Informal Section, on January 21st, Mr. R. Grierson was in the chair, when Mr. E. H. Shaughnessy opened a discussion on broadcasting. The opener was in true informal mood, in turn serious, gay, and ironical, but always entertaining and instructive. A packed meeting included many wireless experts and enthusiastic amateurs thirsting for information or to describe their latest achievements, and the debate might have gone on till very late, but the chairman closed the discussion, in view of the difficulty of getting home.

Mr. Shaughnessy claimed that the policy adopted by the British authorities for the control of broadcasting had been thoroughly justified. It had aimed at putting broadcasting on a self-supporting basis, but the calculations had considerably under-estimated the tremendous growth of licensed receivers, and the developments had been much more extensive than were deemed possible. The British Broadcasting Company's monopoly by its freedom from financial and patent-infringement worries had put British broadcasting far ahead of the rest of the world. Notable consequences also were the familiar use of the valve, the improvement of loud-speaking devices, and the development of the microphone.

Messrs. E. G. Bedford, G. R. Bedford, J. Coxon, W. Day, R. Grierson, W. H. Lawes, H. J. Neill, C. F. Phillips, E. S. Ritter, P. Voigt, and W. E. Warrilow contributed to the discussion, which Mr. Shaughnessy reviewed and closed.

Institute of Transport.—"DOCK AND HARBOUR" AND "CANAL" PREMIUMS, 1923-24.—The Institute announces that the latest date for the receipt of papers for consideration in respect of current awards is June 30th, 1924. The subjects selected are:—Dock and Harbour Premium: "The lay-out and equipment of quay-side transit sheds." Water Transport (Canal) Premium: "The best way of obtaining and retaining traffic on canals and making them profitable to the owners and of service to the community." Those proposing to submit contributions should at once so inform the secretary of the Institute, 15, Savoy Street, W.C.2.

Physical Society of London.—JUBILEE CELEBRATIONS.—The Jubilee Sub-Committee, subject to the approval of the Council, has fixed the three days, March 20th-22nd next, inclusive, for the jubilee celebrations. (March 21st is the actual anniversary of the first meeting of the Society fifty years ago.) It is hoped that the celebrations will include the delivery of the Guthrie lecture on March 20th, a meeting devoted to reminiscences by original Fellows and other Fellows of long standing on March 21st, and a dinner on March 22nd.

Institution of Public Lighting Engineers and Superintendents.—Arrangements have now been made for the inaugural meeting of this Institution to take place at 2 p.m. on Friday, February 15th, in the Board Room of the Holborn Borough Council, 197, High Holborn, London, by the courtesy of the Council. The chair will be taken by Mr. S. B. Langlands, lighting superintendent of the City of Glasgow, the president of the Institution. Mr. Crane Cooper, of Wakefield, having relinquished the office of secretary owing to pressure of business, Mr. W. J. Liberty, public lighting inspector, City of London, Guildhall, has accepted the position of hon. secretary and treasurer (*pro tem.*) until such time as the Institution has become established, and to him all applications for membership, &c., should be addressed. A full programme of the meeting and all particulars will be ready for issue in a few days, and will be sent to applicants.

Junior Institution of Engineers.—At a special meeting on January 25th Prof. Edwin Edser delivered a lecture on "Molecular Attraction and its Relation to Engineering." The lecture was illustrated by a number of interesting experiments, slides, and sketches, and dealt in a practical manner with engineering methods and problems which are based on principles of molecular attraction. Prof. Edser explained how liquids have tensile strength just as much as solids, and demonstrated by sketches the nature of surface tension and capillary attraction. Capillary attraction is the cause of water permeating brick walls, and this can be avoided by a coating of some waxy substance. In order to render road surfaces waterproof they are in many cases treated with emulsified tar. Two experiments showed that the rate at which a minute film of oil will spread over water and even along the interface of two different liquids, such as water and paraffin, is conclusive that excessively high pressures must be present.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

MR. A. W. SCAMMELL has been appointed sales representative in the Midlands by Messrs. Henry Joseph & Co., Ltd.

The staff of the Torquay electricity works recently gave a complimentary dinner to their chief, Mr. H. F. G. WOODS, the borough electrical engineer. Mr. F. Honeywill proposed the health of Mr. Woods, and the latter replied. The party subsequently adjourned to the Torquay Royal Theatre.

Mr. J. WAYNE-MORGAN, consulting engineer, has removed to 9, Mount Stuart Square, Cardiff.

Messrs. PREECE, CARDEW & RIDER, consulting engineers, have arranged shortly to take into partnership Messrs. E. Parry, B.Sc., M.Inst.C.E., M.I.E.E., &c., W. H. Grimsdale, C. W. Kennaway, M.I.E.E., and R. W. Weightman, M.I.E.E. Mr. Parry was, for eight years, chief electrical engineer to the New Zealand Government. During the last 4½ years he has been engineer-in-chief to the English Electric Co., Ltd. Mr. Grimsdale, Mr. Kennaway, and Mr. Weightman have been members of their staff for many years. The name of the firm will remain as heretofore.

Bailie BRUCE LINDSAY was entertained on January 22nd by past and present members of Edinburgh Corporation Electricity Committee, officials of the Corporation, and others. In proposing the health of the guest, Lord Provost Sleigh referred to the whole-hearted and devoted service which he rendered during his convenership of the Electric Lighting Committee, and said that the great power station at Portobello would always be associated with his name. His Lordship presented an electrical standard lamp from members of the Town Council and citizens in recognition of Bailie Bruce Lindsay's services on the Electricity Committee. Bailie Bruce Lindsay, in reply, said the Portobello station was already being found insufficient for the purpose for which it was intended, and whoever succeeded him as convener of the Electricity Committee would have to find means for immensely increasing the production. The demand was just about equal to the supply, and before long would exceed the supply. They were taking steps to provide an additional generator at the station. Councillor Baxter proposed the health of the officials, and said people outside turning over £100,000 a year were drawing salaries twice as large as some of the officials who were dealing with millions.

The Council of the British Cast Iron Research Association has appointed Mr. J. G. PEARCE to the post of director, in succession to Dr. Percy Longmuir, and he will take up his duties on February 1st. Mr. Pearce received his training at, and is a graduate of, the University of Birmingham, and subsequently went through an apprenticeship course at the works of the British Westinghouse Co. (now the Metropolitan-Vickers Electrical Co., Ltd.). He has been associated with Mr. A. P. M. Fleming, C.B.E., in the development of the research department of this concern. Jointly with Mr. Fleming, Mr. Pearce has written "Research in Industry," a recently-published study of the conduct of scientific research and its utilisation in industrial processes. During a large part of 1923 he visited the United States and Canada, spending a considerable time in the Pittsburgh area, and he has also travelled extensively on the Continent. Mr. J. E. Fletcher, M.I.Mech.E., who has been appointed consultant to the Association, will take special care of the practical side of cast and malleable iron research and will deal with the problem directly associated with the practice of members.

Hammersmith Corporation Electricity Committee recommends that Mr. R. A. POLLEY be appointed repairs engineer, at a salary of £408 per annum.

The senior staff of CALLENDER'S CABLE & CONSTRUCTION CO., LTD., held their annual dinner at the Engineers' Club on Friday last. Mr. Howard Foulds, the secretary of the company, was in the chair, supported by Sir Tom Callender, J.P., the guest of the evening, Mr. Theodor Petersen, Mr. Charles Pipkin, and Mr. P. V. Hunter, the joint managers and all the principal members of the London staff and several from the provinces. Mr. Theodor Petersen, who proposed Sir Tom Callender's health, referred to the very long and important association of Sir Tom with the electrical industry, and the affection and regard in which he was held by the whole of his staff, a sentiment which was vociferously applauded. Sir Tom Callender, acknowledging the toast, referred to the long association—nearly thirty years—of Mr. Petersen with the firm, and expressed his satisfaction at the support he had received from the staff during the long and, at times, anxious and troublesome periods through which the company had passed. The bulk of the evening was occupied with an excellent musical programme, under the direction of Mr. Robert Mulvey.

Obituary.—Mr. G. SHEARS.—The death took place on January 11th of Mr. George Shears, head of the firm of George Shears & Sons, Ltd., electrical engineers, Oxford Road, Bournemouth.

MR. G. W. KIDD.—We regret to learn of the death of Mr. George Watson Kidd, chairman of the board of directors of the Hart Accumulator Co., Ltd., of Stratford, London, who passed away suddenly on the afternoon of Tuesday, January 22nd, at his Wanstead home, "Taymouth," St. Mary's Avenue.

Will.—The late Sir H. BABINGTON SMITH left £62,852 gross and £55,084 net personalty.

New Companies Registered.

Bury Lighting and Heating Co., Ltd. (195,137).—Private company. Registered January 17th. Capital, £1,000 in £1 shares. To carry on the business of heating, lighting, and ventilating engineers, whether by steam, gas, electricity or otherwise, founders, engineers, builders, contractors, metallurgists, carriers, chemical manufacturers, chemists, druggists, &c. The first directors are:—J. Lithgow, 54, Hardman Street, Bury, engineer's manager; H. Greenhalgh, 67, East Street, Bury, engineer's draughtsman. Secretary: H. Greenhalgh. Registered office: 9, Elton Road, Bury.

Art Lamp Shade Co., Ltd. (195,136).—Private company. Registered January 17th. Capital £300 in £1 shares. To carry on the business of manufacturers of, and dealers in, shades for electric and other lamps, fittings and ornaments, pedestals, tables, chairs, and furniture, cabinet makers, &c. The first directors are:—H. Hartfield, "Kilcraggen," Canvey Island, caterer; A. Szarvas, 7, Beaumont Crescent, West Kensington, builders' merchant; R. Brosan, 7, Beaumont Crescent, West Kensington, architect; M. Hartfield, "Kilcraggan," Canvey Island, caterer. Solicitors: Engall & Crane, 26, Bedford Row, W.C.1.

Cork Radio Co., Ltd.—Private company. Registered in Dublin January 17th. Capital, £100 in £1 shares. To join with other persons, firms, or corporations in acquiring from the Postmaster-General of the Irish Free State a licence for the erection, establishment, and operation of stations as a public utility service for broadcasting and wireless. The subscribers (each with one share) are:—Hugo Victor Flinn, "Cooleen," Rushbrook, Co. Cork, electrical engineer; Thomas Patrick Dowdall, 4, Alexander Terrace, Cork, butter merchant. The first directors are:—H. V. Flinn (secretary) and E. O'Neill. Registered office: 50, South Mall, Cork.

Cark and District Electricity Co., Ltd. (195,201).—Private company. Capital, £1,500 in £1 shares. To adopt an agreement with A. E. Stringer, liquidator for and on behalf of the Cark and District Electric Supply Co., Ltd., and to develop and turn to account the business of generators and suppliers of electricity formerly carried on by the said company at Cark, Flookburgh, Allithwaite, and elsewhere. The permanent directors are:—E. Cox-Walker, "Meadowfield," Darlington, electrical engineer; F. S. Wrightson, "Waterloo Cottage, Bolton-le-Sands, estate agent. Qualification, £50. Remuneration as fixed by the company. Secretary: F. S. Wrightson. Solicitor: A. C. Kent, 176, Victoria Street, Westminster, S.W.1.

Official Returns of Electrical Companies.

Wholesale Electrical Co. (1922), Ltd.—Particulars filed of £7,000 debentures authorised December 28th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £4,400.

E. Turner & Co. (Manchester), Ltd.—Mortgage dated January 7th, 1924, to secure £250 and further advances, not exceeding in all £1,000, charged on certain land and premises at Blackley, Manchester, at a yearly rent of £10 and £500 owing to the company. Holder: Miss H. M. Hart, 81, Corporation Street, Manchester.

Wholesale Equipments, Ltd.—Debenture dated December 31st, 1923, to secure £1,804 3s. 2d., charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Friend, Wintle & Co., Ltd., 47, St. Mary Street, Cardiff.

City of Carlisle Electric Tramways Co., Ltd.—Satisfaction in full on December 31st, 1923, of charge by way of trust deed dated November 4th, 1914, securing £20,000 6 per cent. second debentures.

Staffordshire Electrical Accessories Co., Ltd.—Satisfaction in full on December 21st, 1923, of debenture dated July 29th, 1921, securing £235.

British Wireless Supply Co., Ltd.—L. Nicholson, of 15, Springfield Mount, Leeds, ceased to act as receiver on January 12th, 1924.

Eastern Telegraph Co., Ltd. (6,338c).—Return dated August 7th, 1923. Capital, £7,000,000 in £5,000,000 ordinary stock and £2,000,000 preference stock. All stock taken up. £7,000,000 paid. Mortgages and charges, £2,000,000.

Pacific and European Telegraph Co., Ltd. (36,683c).—Return dated November 14th, 1923. Capital, £100,000 in £10 shares. All shares taken up. £4 per share called up. £40,000 paid. Mortgages and charges, £66,500.

White, Jacoby & Co., Ltd. (52,494).—Return dated November 2nd, 1923. Capital, £7,500 in £1 shares. 5,794 shares taken up. £1.37 paid. £2,357 considered as paid. Mortgages and charges, £1,500.

Electric Supply Co. of Victoria, Ltd. (66,059).—Return dated October 25th, 1923. Capital, £325,000 in 175,000 preference and 150,000 ordinary shares of £1 each. 175,000 preference and 125,000 ordinary shares taken up. £50,007 paid. £249,993 considered as paid. Mortgages and charges, £91,318.

Western Electric Distributing Corporation, Ltd. (79,057).—Return dated October 11th, 1923. Capital, £100,000 in 50,000 preference and 50,000 ordinary shares of £1 each. All shares taken up. £1 per share called up on 14,245 preference and 31,538 ordinary; 15s. per share on 35,755 preference and 2s. 6d. per share on 18,462 ordinary shares. £74,492 paid, leaving £475 in arrears. Mortgages and charges, nil.

Implitico, Ltd. (138,160).—Return dated December 27th, 1923. Capital, £3,000 in £1 shares. All shares taken up. £3,000 paid. Mortgages and charges, nil.

Electrical Power Engineering Co. (Birmingham), Ltd. (138,377).—Return dated November 9th, 1922 (filed August 22nd, 1923). Capital, £5,000 in £1 shares. 1,945 shares taken up. £600 paid. £1,345 considered as paid. Mortgages and charges, nil.

Mansfield and District Tramways, Ltd. (91,130).—Return dated March 13th (filed October 12th), 1923. Capital, £180,000 in 80,000 preference and 100,000 ordinary shares of £1 each. 77,000 preference and 33,336 ordinary shares taken up. £66,111 paid on 59,767 preference and 6,344 ordinary shares. £44,225 considered as paid on the remainder. Mortgages and charges, £88,235.

Southern Brazil Electric Co., Ltd. (127,856).—Return dated December 5th, 1923. Capital, £507,800 in 650,000 ordinary shares of 10s. each and 182,800 10 per cent. cum. preference shares of £1 each. All shares taken up. £3 10s. paid on 7 ordinary shares. £507,796 10s. considered as paid on the remainder. Mortgages and charges, £679,950.

Electric and General Investment Co., Ltd. (31,506).—Return dated July 23rd, 1923. Capital, £201,500 in 19,900 preference and 20,000 ordinary shares of £5 each and 40,000 deferred shares of 1s. each. All shares taken up. £5 per share called up on the preference, £1 per share on the ordinary, and 1s. per share on the deferred shares. £121,500 paid. Mortgages and charges, £18,805.

E. Turner & Co. (Manchester), Ltd.—Satisfaction in full on January 7th, 1924, of debentures dated August 31st, 1923, securing £100.

Winscombe Electric Light and Power Co., Ltd.—Debenture dated January 14th, 1924, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holders: Westminster Bank, Ltd.

City Notes.

French Electrical Companies.

The net profits for 1922-23 of the *Société des Exploitations Electriques* amounted to 1,394,747 fr. Dividend of 17.50 fr. per share and 21.25 fr. per founders' share.

At an extraordinary general meeting of the *Force Motrice de la Vallée d'Aspe* it was decided to double its capital of 10,000,000 fr. by the issue of 40,000 250-fr. shares at the discretion of the board of management. The board also has authority to issue bonds to the extent of 2½ times the capital shares issued.

After approving the accounts for the year 1922-3 the general meeting of the shareholders of the *Société Artésienne de Force et Lumière* voted a dividend of 60 fr. per share. Later, an extraordinary meeting authorised the raising of the company's capital from 8,000,000 to 24,000,000 fr. by the issue of 32,000 500-fr. shares reserved preferentially to the old shareholders in the ratio of two new shares to each one old share, the balance being distributed in proportion to present holdings.

The ordinary meeting of the *Sud Electrique* passed the accounts for 1922-3 closed on June 30th last, the profit balance being 2,093,781 fr., exclusive of 137,336 fr. brought forward. After making the usual provisions the dividend was fixed at 18.66 fr. gross per nominative share and 17.375 fr. per share to bearer. The year was characterised by unusual and continuous lack of water in the River Vis, on which the company's Madières station is situated. The drought, which was abnormal, lasted throughout the summer of 1922 and extended throughout the whole of the Cevennes district. The result for this district and this station was a fall of nearly 35 per cent., or about 5,000,000 kWh, compared with the hydraulic production of a normal year. The station had in consequence to obtain extraneous current at much greater cost. Nevertheless, the growth of business had compensated for the temporary lack of water-generated energy, the increase on the year having totalled 90,922 fr., which had allowed of a dividend of 8 per cent., equal to that of the foregoing year, at the same time increasing the reserves. The company had decided to double the power of the Avignon reserve station by installing internal combustion engines, and, on the other hand, the *Société Nimoise*, in conjunction with it, had resolved to install at Nîmes an identical station of 3,000 h.p. capacity. The second 1,500-h.p. set at the Avignon station was started on December, 1922; those at the Nîmes station had only been started since the close of the working year, one in July, 1923 and the other in September. The company had had under consideration the provision of fresh sources of energy to cope with the growing calls of consumers for light and power. It had sold to the Société des Forces Motrices de la Vis the water rights which it possessed above the present Madières station. The latter company had increased its capital, in which the Sud Electrique had taken a share.

The increase of the capital from 60,000,000 to 70,000,000 fr. of the *Compagnie Electro-Mécanique* was sanctioned at an extraordinary meeting held in December. The new shares are of 500 fr., with 50 fr. premium. Approval was given to the agreement come to between the company and the Westinghouse Electric and Manufacturing Co. and the Westinghouse International Co., whereby the two American companies grant an exclusive licence, for a limited period, to the Electro-Mécanique Co. to utilise the Westinghouse material in France and its colonies and dependencies. This agreement puts an end to the operations of the two other French companies handling the American materials.

The result of the year's working to June 16th last of the *Société Générale d'Entreprises* showed net profits of 3,388,602 fr., from which a dividend of 10 per cent., or 25 fr., was distributed.

Sunderland District Electric Tramways, Ltd.—According to the *Financial Times* the accounts to October 31st show a profit of £13,933, making available, less interest on prior lien bonds and first mortgage debentures, and including £1,500 brought forward, £8,171. Dividend, 5 per cent. on non-cumulative 12 per cent. preference shares; £1,156 carried forward.

Traction and Power Securities Co.—Net revenue for 1923 £40,736, plus £15,218 brought forward. After putting £5,000 to reserve and paying a total of 8s. 6d. per share, free of tax, £14,655 remains to be carried forward subject to Corporation profits tax. The £8 shares are to be divided into £5 of preference stock and £3 of ordinary stock in units of £1.

Power Securities Corporation.—The accounts for the period October, 1922, to December, 1923, show gross income of £85,535, and the available balance is £65,223. After meeting the preference dividend, putting £15,894 to reserve, and paying 6 per cent. per annum, less tax, £4,099 remains to be carried forward.

Allen, West & Co., Ltd.—In the report published in our last issue, it was stated that the concern's subsidiary companies brought in orders to the value of £12,000. This was an error, the correct amount being ten times as great, namely, £120,000.

Canadian General Electric Co., Ltd.—Dividend of ¾ per cent. on the common stock for the half-year ending February 14th.

Montreal Light, Heat & Power Consolidated Co.—Dividend on common shares of 1¼ per cent. for the quarter ending January 31st.

Western Union Telegraph Co.—Dividend of 1¾ per cent. for the December quarter, making 7 per cent. for the year 1923.

Tottenham District Light, Heat, and Power Co.—Dividends of 8 per cent. per annum on the "A" stock, and 6½ per cent. per annum on the "B" stock.

Stocks and Shares.

MONDAY MORNING.

STOCK Exchange markets cannot be said to have recovered from the remarkable surprise which they encountered upon the publishing of the Labour Cabinet's composition. The previous flatness and depression gave place to a sudden revulsion of sentiment upon consideration of the unexpectedly sound character of the new Government. People who had been storing up their money in deposit accounts were amongst the first to run with it to the Stock Exchange in order to seek permanent investments that pay well on the money. There was none too much floating supply in any of the markets, and the consequence has been such a *volte face*, in the general Stock Exchange conditions, as the City has not witnessed for many years past. Prices have recovered substantially from the low levels at which they were standing, and those who sold on fears of what a Labour Government might do are anxiously looking for new channels into which they can turn their cash.

Markets connected with electricity have not moved as much as some of the others, for the simple reason that they were less affected by the slump than most departments round the Stock Exchange. Investors did not sell their electricity supply shares, at any rate to any noticeable extent, and what shares did come in—causing the dulness to which reference has been made during the past two or three weeks—were welcomed by the dealers who had been on the look-out for an opportunity to obtain shares with which to supply buyers who had effected previous purchases. The cable group went out of favour, but is now rapidly recovering its losses, while in the Home Railway market the rally in Underground stocks has served to lift the Underground Income Bonds to a record level.

These last-named now stand at 102 and the company's shares are correspondingly higher. The £10 shares put on 7s. 6d., and the "A" gained a shilling. Metropolitans are no less than 4½ up; the dividend declaration due on Thursday in this week is expected to make 4 per cent. for the full year 1923; for 1922 the rate was 3½ per cent. Districts are 3 points to the good at 55½.

Home Railway prior-charge stocks are equally in the ascendant. The two newly-issued 4½ per cent. debentures, referred to in this column a week ago, have risen from 3½ discount to 2 discount, or 93½ for the fully-paid stocks. Both of them, City and South London and London Electric, are fully guaranteed by the British Government. Metropolitan District first preference has advanced to 68½; East London "B" debenture is better at 66½; and the same company's third debenture at 25½ shows a point gain.

Few changes ripple the quietude of the market for electricity supply shares. City Lights, after their rise to 50s. and reaction to 42s., are now 2½. Bromptons firmed up to 38s.; Londons to 4½. Tokyo Electric Sixes are 83½. General Electric 7 per cent. debenture is better at 104½. British Thomson-Houston preference at 21s. 3d. show a sixpenny advance. The new Tata Power first debentures have recovered to 93 in company with the general rise in Government stocks. Edison Swan 5 per cent. debenture, upon a moderate demand, gained 2 points at 72½. At this price the yield on the money is still very fair at £6 18s. per cent., but there is not much stock obtainable.

Eastern Telegraph ordinary is 8 up; Eastern Extensions and Westerns are 7s. 6d. and 5s. higher respectively. Great Northerns put on 5s. The market has changed so completely that dealers in the House are humorously complaining of being caught out, and finding themselves landed in loss as a consequence. Anglo-American preferred and deferred are both quoted ex dividend. The wireless group is a little harder, although Marconi's are not quotably altered.

British Columbia Electric Railway stocks continue to reflect the excellent dividend announcement; the deferred is 3 up and the other three issues are all stronger. Brazilian Tractions at 53 are better, and ex the usual quarterly dividend of a dollar. Other Brazilians are firming up. Rio Tramways firsts rose 2 to 82½. Dollar stocks of Canadian and American domicile are fortified by the U.S. rate of exchange, in spite of the little rally in the value of the pound sterling. Montreal Light and Power put on 5 points at 172½. Mexicans also are stronger, Mexican Light and Power firsts being 4 higher at 63½ and the seconds a point to the good at 76.

In the manufacturing group the feature is a rise of 3s. 9d. in British Aluminium ordinary to 21s. 3d. Metropolitan Vickers preference strengthened to 50s., and Henleys to the same figure. Babcock & Wilcox are the turn better at 45s. A long catalogue of small gains in iron, steel and armament shares is evidence of this market's sympathy with general Stock Exchange conditions. Even the rubber share list is a little better, there being some idea of the material rallying from the present price of 1s. 2d. per lb. Business all round is better and the public are taking a more lively interest in the purchase of stocks and shares than has been the case since the announcement of the General Election.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Jan. 28, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	£ 1	12	12	38/-	+6d.	£5 6 4
Charing Cross Ordinary	5	9	14½	14	—	5 3 7
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 7 5
Chelsea	1	6	10	8⅝/-	—	5 14 8
City of London	1	14	15	9½	—	5 13 4
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 9 1
County of London	1	8	10	11⅜	—	5 3 8
do. do. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Edmundson's Ordinary	5	Nil	7	8¾xd	—	5 13 0
do. 6 % Pref	5	12/-	6	4¼	—	6 3 0
Kensington Ordinary		10	12	108	—	5 13 6
London Electric	5	4	10	4½	+ ⅛	5 3 1
do. do. 6 % Pref. ...	5	6	6	5½	—	5 9 1
Metropolitan	1	7	8½	18	—	5 4 9
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	Nil	9½	16/3	—	5 1 6
do. 5 % Pref. ...	1	5	5	16/6	—	6 0 0
do. 7 % Pref. ...	1	7	7	22/6	—	6 4 5
Notting Hill 6 % Pref.	10	6	6	9½	—	5 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	17/3	—	Nil
do. 6 % Pref. ...	1	2½	5	17/6	—	5 17 1
St. James' and Pall Mall ...	5	13	14½	11⅞	—	6 3 5
South London	1	7	10	11⅞	—	5 13 4
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 5
Westminster Ordinary	5	10	12	10	—	6 0 0
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/9	—	7 5 1

HOME RAILS.

Central London Ord. Assented	Stock	4	4	71½	+2	£3 12 0
Metropolitan	,,	2½	3½	76½	+4½	4 11 6
do. District	,,	1	3	55½	+3	5 9 1
Underground Electric Ordinary	10	Nil	Nil	3½	— ⅛	Nil
do. do. "A" ...	1	Nil	Nil	8/6	+1/-	Nil
do. do. Income	Bonds	4	5	102	+2	£5 17 8

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	102xd	—	£5 17 8
do. Def.	,,	1½	84/6	22¼xd	—	6 13 4
Chile Telephone	£	6	6	8½	—	5 3 3
Cuba Sub. Ord.	10	7	7	7½	—	9 13 3
Eastern Extension	10	10	10	16	+ ⅛	6 5 0
Eastern Tel. Ord.	Stock	10	10	165½	+8/-	6 0 10
Globe Tel. and T. Ord. ...	10	10	10	16½	—	6 1 5
do. do. Pref. ...	10	6	6	10⅞	—	5 11 7
Great Northern Tel.	10	24	22	22½	+ ½	7 16 0
Indo-European	25	10	7	23½	—	£5 7 8
Marconi	1	25	15	1⅝	—	7 15 0
Oriental Telephone Ord. ...	1	12	12	1⅝	—	£7 8 0
United R. Plate Tel.	£	8	8	6½	—	£6 3 1
West India and Panama ...	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16	+ ½	£6 5 0

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	£	5½	13½	21⅞	—	9 7 1
do. do. 2nd Pref.	£	Nil	6½	21⅞	—	9 15 6
do. do. 5% Deb.	Stock	5	5	74	—	6 15 3
British Electric Traction Ord.	,,	4½	5	67	—	7 9 3
do. do. 5% Pref.	,,	5	5	98½	—	5 1 10
Brazil Traction	100	Nil	4	53xd	+1½	7 11 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	86½	+1	5 15 7
do. do. Preferred	,,	5	9/-	87½	+2	£5 10 6
do. do. Deferred	,,	3	12/-	103½	+3	£6 4 0
do. do. Deb. ...	,,	4½	4½	70½	+1	6 7 0
Lond. & Sub. Trac. 5 % Pref.	£	3½	5	6/-	—	16 13 4
London United Tram. Deb. ...	Stock	4	4	56	+1	7 3 10
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	63½	—	7 6 0
do. 6 % Bonds ...	—	Nil	Nil	65½	—	Nil
Mexican Light Common ...	100	Nil	Nil	18	—	Nil
do. Pref.	100	Nil	Nil	44½	—	Nil
do. 1st Bonds ...	—	Nil	5	63½	+4	7 17 6

MANUFACTURING COMPANIES.

Babcock & Wilcox	£ 1	15	20	2¼	+6d.	£4 9 0
British Aluminium Ord. ...	1	10	5	1⅛	+ 1/16	4 14 1
British Insulated Ord. ...	1	15	15	33	—	6 6 4
Callenders	1	15	15	33	—	6 6 4
do. 6½ Pref.	1	6½	6½	24/3	—	5 7 1
Crompton Ord.	1	10	5	½	—	10 0 0
Edison-Swan	£/-	10	Nil	4/3	—	7 7 6
do. do. 5% Deb.	Stock	5	5	73½	+2	6 18 0
Electric Construction	1	10	10	29/6	—	6 15 7
English Electric	1	5	5	17/-	—	5 17 5
do. do. Pref.	1	6	6	1	—	6 0 0
Gen. Elec. Pref.	1	6½	6½	22/-	—	5 18 2
do. Ord	1	10	5	19/3	—	5 6 0
Henley	1	15	15	3½	+ ⅛	6 6 0
do. 4½ Pref.	£	4½	4½	4½	—	5 3 10
India-Rubber	1	10	—	⅛	—	£3 6 0
Met.-Vickers Pref.	3	8	8	3½	+ 1/16	6 6 0
Siemens Ord.	1	10	10	15/9	—	Nil
Telegraph Con.	12	20	20	23	—	£5 4 1

*Dividends paid free of Income Tax.

The Condition of the Electrical Industry in Italy.

By Major J. S. BARNES.

For the following information the writer is chiefly indebted to Commendatore D. Civita, Director of the Italian Electrical Trades Association; to Commendatore Alberto Lodolo, of the Credito Italiano; and to the American Commercial Attaché in Rome, Mr. MacLean, whose bulletin on "Electrical Equipment in Italy," published by the American Bureau of Foreign and Domestic Commerce, has been largely quoted and paraphrased.

Italy's lack of coal and oil, together with her large resources in water power, has stimulated the use of electricity throughout the peninsula. Her industries chiefly depend on a cheap and abundant supply of electric power. A great number of new hydro-electric plants are in course of construction, for the demand for electricity, which is likely to continue on the increase for some time to come, considerably exceeds the supply.

According to the latest statistics, hydro-electric development in Italy had reached by the end of 1922 a total capacity of 1,594,969 kW installed, with a total potential output of at least 5,000,000,000 kilowatt-hours. About eight-tenths of this is utilised for industrial purposes. The development since the war has been remarkably rapid, and the last year has shown a further notable increase. It is conservatively calculated that by 1928, 2,400,000 water horse-power will have been harnessed. To this must be added 395,108 kW from thermic plant already installed.

This widespread use of electricity in Italy has naturally given rise to a demand for electrical machinery and equipment, which has increased in the same proportion as the consumption of power.

Before the war, the greater portion of this machinery was supplied by German firms, notably by the A. E. G. and Siemens Schuckert. Now there are few classes of electrical goods not being manufactured in Italy, and the output is steadily increasing. Nevertheless, Italy represents still a good market for electrical equipment provided price competition can be met.

No separate statistics are available for the manufacturers of electrical goods, for the electrical industry is included among the other engineering trades, which represent a capital investment of over £17,000,000 (calculated at the exchange of 100 lire to the £1 sterling), and give employment to over 400,000 workers. The percentage of this total represented by the electrical industry is considerable; and at the present time the principal factories concerned are working practically to capacity.

The local industry produces generators and motors of every type. Switchboard material for central power and distributing stations and power-transmission material is all manufactured in Italy, and local production supplies most of the demand. Certain switchboard material is, however, of American or German manufacture. Alternators have been built in Italy up to a capacity of more than 15,000 h.p. Three-phase electric locomotives for use on the railways, which are being electrified as rapidly as funds will permit (Italy has already several hundred miles of electrified railway, notably the main line section, Mont Cenis-Turin-Genoa), are nearly all manufactured locally. These locomotives have direct-connected motors with power applied to all of the wheels, and are designed to maintain a speed of 19 miles per hour when hauling trains of 500 tons on the heaviest grades. The line materials are generally Italian or American. The problem of adopting a standard frequency, which would make possible an exchange of current between all the various plants, is now receiving special attention. At present 46 per cent. of the current used has a frequency of 42 cycles, 41 per cent. a frequency of 50 cycles, 3 per cent. of 45 cycles, and 10 per cent. is direct current. The electrified State railways have been using a frequency of 16 cycles, necessitating the construction of special plant. It appears, however, to be the intention of the Government either to install machinery for converting the normal industrial current or to adopt an industrial frequency.

Among the chief firms in Italy manufacturing electrical equipment are the following:— The Tecnomasio Italiano Brown, Boveri, a subsidiary of the Swiss Brown, Boveri; Nicola Romeo & Co.; the Società Franco Tosi, now controlled by American capital; Riva, Ltd., who manufacture water turbines; Magrini, Ltd., who specialise in switchboard equipment; Hensenberger, Ltd., of Monza, and the Società Italiana Accumulatori Elettrici (batteries); Ercole Marelli & Co., and V. Tedeschi & Co. (electric wire and cables).

Imports are largely confined to special machinery, such as special rheostats, multiple speed motors, and 3,000 revolutions per minute alternators for use in connection with steam turbines. The import of incandescent lamps into Italy has also been large, for the local industry hitherto has found it difficult to meet foreign competition. But it has lately been decided to increase the tariff on this class of goods in order to stimulate the home trade. German Bosch magnetos are largely imported.

Another important line of goods which finds a ready market in Italy, since here the latter cannot supply her own requirements, is measuring instruments. In 1922, meters valued at more than 17,000,000 lire were purchased from abroad. The same is true of prepared carbon and graphite for electrical use, imports having totalled more than 10,000,000 lire in 1922. Imports of porcelain insulators were also heavy, and there is a considerable market for the better class of lighting fixtures, only the cheaper and less artistic kinds being produced in Italy or imported from Germany.

Electrical machinery in Italy is not standardised to the same extent as in other countries; and Italian engineeds frequently prefer to draw up their own specifications, embodying their own ideas, instead of accepting standard types. This should be borne in mind by those who hope to enter the Italian market. Manufacturers should also follow the example of German firms and quote prices in Italian lire.

Besides holding their own in the home market in the majority of lines, Italian firms are gradually creating an important export trade. In 1922 over 47,000,000 lire of electrical machinery was exported; and if we consider that the manufacture of electrical equipment in Italy is a comparatively new industry, which is obliged to face the keenest sort of competition, the showing made is very creditable.

Italy's Foreign Trade in Electrical Material.

IMPORTS.	1922. Quantity, Quintals.	1922. Value, Lire.
Electric generators and motors:		
Without collector commutators ...	14,016	13,432,940
With collector commutators ...	6,193	8,690,905
Static electric transformers	10,257	9,812,590
Batteries	329	359,616
Magnetos	209	1,394,062
Telephone and telegraph apparatus ...	1,497	11,234,057
Electrical apparatus not specified and parts thereof	10,514	18,067,246
Ammeters and other electrical measuring instruments, excluding meters...	148	1,152,605
Meters	5,476	17,416,503

IMPORTS.	1922. Quantity, Quintals.	Value, Lire.
Prepared carbon and graphite:		
For electric furnaces and electrodes	24,163	9,950,744
For lamps, batteries, and brushes with metallic accessories	101	404,284
Other	751	758,627
Insulators of earthenware, porcelain, &c.:		
Plain:		
White	8,913	4,202,228
Coloured or decorated	344	318,823
With accessories of metal or other material:		
White	513	301,468
Coloured or decorated	2,231	1,620,335
Insulators of glass	4,671	1,410,710
Electric lamps:		
Up to 35 grams	7,373,277 130,000	23,790,968
From 35 to 70 grams	6,399,855 175,940	27,825,796
Weighing more than 70 grams ...	199,744 52,260	3,240,689
Copper wire:		
Round	556	734,274
Other form	41	75,671
Varnished, tinned or nickelled ...	405	495,103
Gilded or silvered	174	1,293,614
Copper cables and cords	8	14,541
Insulated wires and cords:		
Formed of wires having a diameter greater than 0.5 mm.	483	854,569
Formed of wires having a diameter of 0.5 mm. or less	332 94	353,286
Insulated cables protected with metallic material, including submarine cables:		
Formed of wires having a diameter greater than 0.5 mm.	1,895	1,453,469
Formed of wires having a diameter of 0.5 mm. or less	7	12,014
		160,670,737
EXPORTS.		
Electric generators and motors:		
Without collector commutators ...	1,392	2,132,494
With collector commutators ...	14,324	18,640,026
Static electric transformers	400	552,018
Batteries	2,325	2,807,523
Magnetos	344	2,037,231
Telephone and telegraph apparatus ...	521	1,951,028
Electrical apparatus not specified and parts thereof	3,035	5,349,648
Ammeters and other electrical measuring instruments, excluding meters...	11	63,892
Meters	46	119,592
Prepared carbon and graphite:		
For electric furnaces and electrodes	1,373	209,183
For lamps, batteries and brushes with metallic accessories	14	7,050
Other	4	12,004
Insulators of earthenware, porcelain, &c.:		
Plain:		
White	136	174,180
Coloured or decorated	2	3,000
With accessories of metal or other material:		
Coloured or decorated:		
White	696	1,118,371
Insulators of glass	2	5,069
Electric lamps:		
Up to 35 grams	35,436	122,751
From 35 to 70 grams	40,497	160,770
Weighing more than 70 grams ...	165	4,460
Copper wire:		
Round	2,137	2,082,068
Other form	20	37,637
Varnished, tinned or nickelled ...	56	47,660
Gilded or silvered	4	23,587
Copper cables and cords	442	427,051
Insulated wires and cords:		
Formed of wires having a diameter greater than 0.5 mm.	3,625	4,607,234
Formed of wires having a diameter of 0.5 mm. or less	7,355	616,929
Insulated cables protected with metallic material, including submarine cables:		
Formed of wires having a diameter greater than 0.5 mm.	7,117	3,762,821
Formed of wires having a diameter of 0.5 mm. or less	52	62,491
		47,137,765

Granting the existence of a market for electrical equipment, the next question from the standpoint of a British manufacturer, is that regarding competitive conditions. It would be unwise to underestimate the importance of the Italian electrical industry, or the strength of the position that has been acquired in the market by German firms after years of patient effort, and of profound study of the requirements of the Italian trade. Competition is decidedly keen, and will continue to increase rather than to diminish. At the same time, if a sincere effort is made there would appear to be no reason why in certain lines, especially that of generators and motors, lighting fittings, insulators, and incandescent lamps, purchases in Great Britain should not be increased. The United States is doing a large trade in comparison with Great Britain, too large by half in comparison. Although the high protective tariffs may make it difficult for foreign countries with a high exchange to compete favourably with local products, where these are not sufficient for the home demand, Great Britain which enjoys the most-favoured-nation clause should be able in many lines to hold her own against competitors enjoying no special advantages.

There is room, too, for the employment of British capital in Italy. The electrical industries in Italy are likely to continue to expand, and British capital would be welcomed to assist. The Italian workman is highly skilled and, although often slow, there is no harder or more sober worker. The general conditions of the country are excellent, and the commercial budget is balanced. The employment of British capital in Italy for the further development of the Italian electrical industries would be likely to be a safe and, with the lira tending to steady improvement in value, a distinctly remunerative investment.

An American Super-Sensitive Microphone.—The perfecting of an electric ultra audible microphone, invented by Dr. Phillips Thomas, which, it is claimed, will permit scientists to record sound vibrations that now are too rapid or too faint for the human ear to detect, has been announced by the Westinghouse Electric and Manufacturing Co. According to Mr. S. M. Kintner, director of research for the Westinghouse Co., in its experimental stage the microphone has been used successfully to transmit by radio telephony the highest notes of the voice, and of musical instruments which the ordinary transmitter and receiver reproduce as mere noises. Mr. Kintner declared that the device had been perfected and simplified to a point at which it could be used by vessels at sea for picking up the warnings of fog horns or other sound warnings beyond the range of the human ear; in studying the finer sound vibrations of organs of the human body, such as the heart and brain; and in the realm of the entomologist, who has tried in vain to pick up sounds known to be made by tiny insects, but inaudible to humans.

"With the new device, which will register sound of an infinite number of vibrations, from 20,000 up, we will be able to reproduce and record, if not to hear, all the sounds of the earth of which heretofore we have remained in complete ignorance." Dr. Thomas's device consists of a ring of insulating material, on the inner side of which two tiny electrodes are set opposite. A high voltage is passed through the electrodes, producing a soft, purplish, glow discharge as it flows through the air between them. This light, it is claimed, is highly sensitive to sound vibrations, flickering with the sounds and causing change in the flow of current which can be transmitted to reproducing machines or recorded by a stylus.—*Reuter* (New York).

The World Power Conference.—From the preliminary announcement that has been issued regarding the conditions and privileges of membership of the World Power Conference that is to be held at Wembley from June 30th to July 12th we gather that official delegates appointed by the participating national committees are entitled to free membership. Any applicant is entitled (subject to the approval of the Executive Committee) to become a member of the Conference on payment of £2, which will go toward the Conference expenses. Members will receive a membership ticket which will entitle them to free admission to the exhibition and the Conference Halls during the period of the Conference. Copies of the papers will be supplied to members at a nominal price. There will be a number of official tours to places and works in Great Britain, hydro-electric stations, &c., in Sweden, Norway, France, Italy and Switzerland, after the Conference. We recommend any of our readers who are interested in the arrangements to write to The Secretary of the Conference, at 36, Kingsway, W.C.2, asking for copies of these and other particulars.

British Trade in New Zealand.

A REPORT on the economic and commercial conditions of New Zealand up to July, 1923, by Mr. N. Elmslie, His Majesty's Trade Commissioner in Wellington, has been issued by the Department of Overseas Trade.

Mr. Elmslie quotes certain statistics of the Dominion's foreign trade, which confirm the general opinion that the heavy stocks of goods that resulted from extensive importations in 1920 have been liquidated and that buying is now proceeding on a normal scale. He points out that the monthly returns of imports, which showed a rapid fall during the first half of the year 1921, and averaged about two and two-third million pounds during the 12 months from June, 1921, to June, 1922, expanded steadily during the latter half of 1922, and for the first six months of last year have averaged over three and a-half million pounds in spite of the lower general level of prices.

Recovery of Purchasing Power.

The monthly returns of exports are also of interest. The average figure for the first six months of 1921 was slightly over four and a-half million pounds; for the corresponding half of 1922 it fell to rather under four and a-half million pounds, and for the first six months of this year a substantial rise to 5.2 million pounds per month has been recorded. Bearing in mind that butter and cheese brought exceptionally high prices in 1921, and that heavy shipments of wool were made from accumulated stocks in 1922, it is very satisfactory to find so substantial an increase recorded for the first half of last year, when conditions were in every way more normal.

The banking returns and the reports of production in the important pastoral industries, which are dealt with in later sections of the report, also show a welcome improvement, and support the hope that the difficulties of the post-war period have been so far overcome that a period of prosperity and steady trade expansion may be anticipated.

It is satisfactory to learn that the Dominion is now buying on approximately the same scale as in 1914, and that nearly as large a proportion of the imports comes from the United Kingdom as in the years immediately before the war. It is true that there is still a considerable quantity of goods obtained from foreign countries that could be supplied by the United Kingdom, but the greater part consists of lines in which foreign manufacturers have a well-established connection, or of goods of special design which suits the tastes and habits of New Zealand better than the standard products of the United Kingdom. This trade, says the Trade Commissioner, can be obtained only by manufacturers paying much closer attention to the market, adapting their designs to suit local requirements, and organising their selling methods in order to meet foreign competition on equal terms.

A Strong Recommendation.

The report points out that expansion of the total volume of New Zealand trade, resulting from the growth of the Dominion, and the consequent increase of its prosperity and purchasing power, will be a very important factor. Special attention is therefore devoted to describing the position of the chief producing industries. The result is sufficiently encouraging to justify a strong recommendation to merchants and manufacturers to devote closer attention to the market. It is pointed out that competition is very keen and many foreign firms who obtained very profitable business in the Dominion during the war years are exerting themselves to retain their hold, but the preference given to British products by the Customs tariff is so considerable, and the desire to purchase all requirements within the Empire is so genuine and strong, that if British firms will only take the trouble to establish personal touch with the market and show willingness to give the service that is asked, foreign competition can be successfully met.

Hydro-Electric Development.

The progress that has been made in the development of the Dominions hydro-electric power has been recorded from time to time in these columns. Mr. Elmslie mentions that the total expenditure during the financial year ended March 31st was £450,247, and summarises the work done.

The Lake Coleridge power house has been brought up to the full capacity of the existing tunnel by the installation of two additional generators of 3,000 kW each, making the total power installed 12,000 kW. The load has grown rapidly, and has already reached 10,500 kW, and it has, therefore, been decided to proceed at once with further extensions which will necessitate a second tunnel and intake works. The proposed extensions will consist of two sets, each of 7,500 kW, with provision for a third set to be added when necessary. Transmission lines have been completed to Ashburton and Timaru.

The Hora Hora power house has been in operation throughout the year, the existing plant, 6,900 kW, is overloaded, and demand is increasing in the Waikato. The Auckland Electric Power Board is also negotiating for a supply from Hora Hora in advance of the supply from Arapuni, which will not be available before 1928. An extension of two sets, each of 2,000 kW, has been put in hand, and the transmission line to Auckland is under construction.

No work has yet been done in the main plant at Waikaremoana, but as a small supply was urgently wanted at Wairoa the two exciter sets were installed and have been giving service since December, 1922. No statement has yet been made as to when work on the main plant will be commenced.

The Mangahao plant is making substantial progress, the tunnels and headworks are well in hand, the power house is under construction, and it was hoped to commence installation of the machinery in November. The Minister of Public Works has stated that he hopes to have the plant ready to operate about next June. Transmission lines to Wellington, Marton, Dannevirke and Masterton are under construction, and surveys are being made for lines to Napier and Wanganui.

It is proposed to proceed at once with the installation of three sets of 15,000 kW each at Arapuni. Contracts have already been let for the construction of an access road, and specifications have been drawn up and issued for the construction of the dam and headworks, while tenders for the power-house building and plant will be called shortly.

Dunedin City is extending the Waipori Falls station by the addition of a 3,000-kW set, and is making provision for the ultimate installation of three more such sets. The Southland Power Board is pushing on the Monowai scheme of two 2,000-kW generators, with provision for extension by four additional sets. The New Plymouth Borough has plans in hand for a station of 4,500 kW on the Waiwakaiho River, and the Taranaki Power Board proposes to construct a small station of 1,500 kW at Tariki.

Several smaller power stations are in hand, and preliminary investigations have been made of sources of power for Otago, Marlborough, Nelson and Westland.

Altogether the Public Works Department are planning to spend well over a million pounds per year on hydro-electric power development and transmission during the next six or eight years. Reticulation and distribution are undertaken by power boards in each district, who make their own financial arrangements. It will, therefore, be obvious that there is a prospect of very large orders for electrical machinery, plant and fittings, being placed during the next few years.

Benefits of Preference.

The report includes the usual analysis of imports by competitive and non-competitive classes, and gives tables showing the values of goods obtained from the more important sources of supply and the proportion of the Dominion's trade secured by each. It is satisfactory to see that the United Kingdom continues to increase its share of the total trade, and that in the competitive group, which includes all the manufactured goods, has nearly regained the position held in 1914. The United States and Australia have largely lost the increased share of the trade that they obtained during the war, but Canada has held her position, and during the last half-year has increased her trade. There can be no doubt, says Mr. Elmslie, that the increased preference granted to the United Kingdom by the customs tariff of November, 1921, has been of material assistance in restoring the trade position, although it is still, perhaps, too early to judge its full effects. The report gives the following table, showing the total imports in the machinery class, together with the shares of the countries named:—

Country of Origin.	Competitive. 1921.	1922.
United Kingdom ...	£1,997,696	£1,761,339
Australia	165,444	82,005
Canada	124,203	97,330
United States	1,241,118	626,371
Japan	20,036	4,595
Germany	—	3,551
Other countries ...	186,685	194,134
Total	£3,735,184	£2,769,325

It will be seen from the above table that there has been a decrease in the total imports, and that the share of the United Kingdom has considerably increased, in connection with which the following table is of interest as showing the percentage shares of each of the principal competing countries:

Country of Origin.	1921. Per cent.	1922. Per cent.
United Kingdom	53.5	63.6
Australia	4.4	3.0
Canada	3.3	3.5
United States	33.2	22.6
Japan	0.5	0.2
Other countries	5.1	7.1
	100.0	100.0

The largest item in the machinery class is the electrical group. The values of imports of electrical machinery, accessories and appliances in 1921 and 1922 respectively were: From the United Kingdom, £867,735 and £695,781; and from the United States £464,520 and £230,757.

Electric Starting and Lighting Equipment for Automobiles and Motor Cycles.

By A. C. BURGOINE.

(*Abstract of paper read before the* INSTITUTION OF AUTOMOBILE ENGINEERS.)

ELECTRIC lighting became fairly well established by 1910, and two years later the electric starter was being widely adopted by American car builders. The electric starter did not capture the field without opposition, but its superior performance and the almost entire absence of personal trouble entailed very quickly caused the system to become firmly established. At present practically every vehicle made in Canada and America has a complete electric lighting and starting set as a matter of course, although in this country it is still quite usual to find small cars without starters, while electrically-equipped commercial vehicles are the exception rather than the rule.

In its simplest form a lighting set may consist of lamps and a battery, an arrangement fitted on many cycles and combinations. The complete lighting set on modern lines consists of a shunt-wound direct-current generator driven by the engine and connected through an automatic charging switch to a battery of accumulators, in addition to lamps with their switches and cables. The connections are so arranged that when the dynamo is running below a certain speed the lamps are supplied from the battery alone; above that speed the dynamo furnishes the required current, plus a small surplus to keep the battery well charged. In some cases, however, the output of the dynamo is insufficient for this, so that when all the lights are on there is a small discharge from the battery.

The simplest means of turning the engine is an electric motor, supplied from the lighting battery, the capacity of which is somewhat increased to cope with the extra duty. The large majority of starters drive directly on the flywheel through the medium of plain spur gears. A Bendix pinion is utilised to enable the gears to be free under normal conditions, but to engage automatically when current is switched on for starting.

All but the cheapest cars are now fitted with electric starters, but they are not used on motor-cycle engines, although it is understood that experiments have been carried out by at least one maker; probably the extra weight and cost entailed will forbid their adoption. On commercial vehicles starters are not yet very common, although there are some signs that they are beginning to receive the attention they deserve.

Large engines, such as are fitted in lorries and 'buses, require a considerable effort to start them, so that powerful motors and large batteries are needed. On the other hand, their fuel consumption when running light is considerable, and on some services stops are frequent and of fairly long duration, and it is not at all unusual to see engines running idle for spells of ten or fifteen minutes while goods are being handled. If the light-load consumption of an engine be no more than a gallon per hour, and the number of stops ten per day, of an average duration of but five minutes, on 300 working days per annum, the fuel cost will amount to approximately £18. While this sum would pay handsomely for the interest on, and the upkeep of, a starter and battery, and for the extra size of dynamo required, there would be a further gain owing to the reduced carbonisation in the cylinders and to the lessened wear and tear of 250 hours' running. It is during periods of light running that most of the oil is sucked up past the pistons, eventually to be carbonised and finally to be scraped out at considerable expense in direct labour and loss of service, and if this could be reduced the saving would probably be quite as much again as the figure mentioned.

Objection may be raised that the ordinary lorry driver would not be able to look after a starting set, and that the parts would not stand up to the heavy work and excessive vibration to which they would be subjected. The author believes these objections to be without foundation, as a starter is much simpler and more robust than a magneto, as also is a dynamo, while the driver could be relied upon to look after an accessory that could save him much hard physical work. Perhaps the weakest link in the chain would be the battery, but this would appear to be almost entirely a matter of correct design and good workmanship, coupled with reasonably careful attention. Modern batteries will stand the most brutal treatment, and as a few pounds weight would not be an insuperable objection on a lorry weighing several tons, it should be possible to meet the exacting requirements with success.

The position with regard to standardisation is extremely unsatisfactory, the fault lying to a great extent with car designers, who persist in demanding special types of machines, or ordinary machines modified in some small detail. Possibly if the manufacturers of the apparatus were to get together and mutually bind themselves to supply only certain patterns, car designers would accept what they were offered. One manufacturer lists no less than 27 types of dynamo, plus seven types of dynamo combined with an ignition distributor, and actually goes so far as to offer to design special patterns upon demand. Probably the whole range for ordinary cars could be covered by not more than four machines, using armatures of two diameters built up in various lengths. As a concession to the car designer it might be permissible to supply the four types with alternative end-plates for flange or strap fixing, in which case the range of eight types would be more than ample to meet all reasonable requirements. Strenuous efforts should be made by the manufacturers to persuade car designers to accept the flange mounting, in view of its technical superiority, and in course of time doubtless only four types would be required. In addition, it might be necessary to produce one or two extra-large machines for commercial work on 'buses, where many interior lights are needed, but there certainly need not be more than two patterns for such purposes.

Exactly the same arguments apply with regard to engine starters. At most three types would suffice, permitting for a time alternative mountings. Here, again, perhaps one extra-large machine would be required, though it by no means follows that the vehicle requiring the most lighting current will require also the largest starter.

Car lighting is carried out at present in general at six and twelve volts. In America the six-volt system is in the ascendancy, but in this country and on the Continent it is more usual to use twelve volts on all but the smaller cars. There are two principal reasons for the greater popularity of the lower voltage in America. On the one hand a three-cell battery is a little cheaper than a six-cell battery of equal effective capacity, while the smaller number of cells to look after appeals to the American driver; it is very much easier to make a satisfactory ignition coil to work at the lower voltage; as a large proportion of American cars have coil ignition this is a powerful argument. On the other hand, better results are obtained from the starter at the higher voltage, and this applies particularly in the case of the combined machine or dynamotor. As regards insulation, there is really nothing to choose between the two systems. For the lower voltage the lamp filaments are stronger, but the cables have to be heavier to carry the doubled current with the same voltage drop, this being a real consideration with the already heavy starter cable.

Wiring may be completely insulated, with separate go and return leads, or on the earth-return system with one insulated lead and the circuit completed by way of the metallic portions of the car and any metal sheathing used on the cables. The twin-wire system is technically superior, but the earth-return system is slightly cheaper, which doubtless accounts for its popularity in America. The risk of short-circuits and breakdowns through defective insulation or chafed cables is much greater with the single-wire system, and troubles may arise through poor contacts in the earth circuit. Where coil ignition is used the ignition circuits are on the single-wire system, and this may be an argument in favour of adopting the earth-return throughout; the author would prefer rather to change the ignition to a twin-wire system and retain this for lighting also. All things considered, the twin-wire is the better system, but the other can be made satisfactory if well carried out, and may be used when cost is of importance.

Certain designers do not appear to have realised the importance of making provision for the electrical equipment until the design of the car has progressed so far that the best possible arrangement cannot be worked in.

Special dynamos are found on all classes of chassis. There may be cases in which the total cost of the chassis has been reduced, or at least not increased, by the adoption of a special model, but the author cannot call to mind any instance of the departure from standard really being warranted. It is probable that in practically every case where a special machine has been used the ultimate cost has been increased, while the difficulties attendant upon the obtaining of spares (even if but few cars ever require any parts) must prejudice owners and cause some loss of goodwill.

While it is almost universal to find the dynamo driven directly by the engine, there are still a few cars retaining belt drive from the clutch shaft. Tandem driving of the dynamo and pump, the dynamo and magneto, or even of all three units, is quite common, particularly on French cars.

On motor cycles the disposition and drive of a dynamo are not easy problems to solve in a really satisfactory manner. One design which can be fitted to practically any machine without difficulty consists of a worm-wheel attached to the spokes of the rear wheel, with a flexible shaft coupled to the enclosed worm and leading forward to the dynamo.

Speaking generally, it is desirable to drive the dynamo at the same speed as the crankshaft, by gears or by silent chain with

adequate means of adjustment, and to select a machine that will give the required output with a reasonably low cutting-in speed. The ordinary third-brush machine, with a drooping characteristic curve, will then charge the battery at a good rate when running in towns, and will not too grossly overcharge it on fast runs in the open country. In certain cases it may be permissible to run a dynamo twice as fast as the crankshaft, but this is the extreme limit.

On modern engines it is still possible in certain quite recent designs to severely criticise the arrangement of the starter. On the majority of recently-designed engines the starter occupies one of two well-defined positions, in either of which it can be made quite accessible. Perhaps the favourite is the starter attached to the forward side of the flywheel housing by a flange and studs; it is, however, sometimes fitted in a split socket with a clamping bolt, and is then usually quite easy to remove. Frequently there is some other component in line with the starter, so that the latter cannot be removed without first taking off other parts, one small car requiring to have the steering column taken down before the starter brushes and commutator can be inspected; there is absolutely no justification for such a state of affairs as this, and the designer cannot be too strongly condemned.

In the vast majority of applications of the electric starter the drive is by Bendix pinion gearing directly with teeth on the rim of the flywheel, and on the whole this is a simple, cheap and satisfactory method. Of starter mountings and drives in general it may be remarked that the object of the designer should be to apply the motor torque as directly as possible to the flywheel, and to place the machine in a position where it will be completely accessible and at the same time protected from mud and dirt. Careful attention should be paid to the accuracy of the gears and the mounting of the starter at the correct centre-distance lest the efficiency of the drive be seriously impaired and the job rendered unsatisfactory to the user.

The efficiency of these small motors is not particularly high over the working speed range, so that if the loss in the drive by reason of poor gears or springing shafts be very great, the power may be insufficient to turn the engine quickly, and therefore the current taken will be excessive. Owing to the great variations between individual engines of one design, to say nothing of the much greater differences that may exist between types, it is almost impossible to state what the torque required to start an engine is likely to be. Starters are available of which the stalled torque ranges from about 5 up to 40 lb.-ft. Larger machines are required on four-cylinder than on six- or eight-cylinder engines of equal piston displacement, owing to the facts that the torque curve is more irregular and that the peaks must be considered. Under the worst conditions of a low temperature and gummy oil, an engine may require four or six times the power to turn that might be necessary under favourable conditions, considering the friction alone. To this load must be added that due to the compression in the cylinders, while the load due to suction against a practically closed throttle may be not inconsiderable. As a very rough guide it may be said that the starter should be capable of exerting a stalled torque of about 5 lb.-ft. per litre of piston displacement of the engine, but as the characteristic of the motor must be considered in connection with the gear-ratio and the type of engine, the only safe guide is the manufacturer's experence.

British manufacturers have preferred to use the plain dynamotor up to its practical limit of about a 12-h.p. engine, fitting two separate machines on larger engines, a practice which appears likely to persist. The simple dynamotor has certain advantages over the two-machine outfit, of which the most important to many car builders is its lower cost, another consideration being the silence of the drive when acting as a starter. On the other hand, the disadvantages are numerous and very real, becoming more serious as the size of the engine, and consequently the starting torque, increases. Considering, first, the functions of a starter, it will be admitted that a high gear-ratio is advisable, in order that a small motor may be used and the initial current kept within reasonable limits, yet with the ability to break loose the engine under bad conditions. When a separate starter is used the gear-ratio is of the order of 10 or 15 to one, according to the sizes of the engine and the motor, and on large aircraft engines where weight is of great importance, ratios of from 100 to 150 to one have been used in order to obtain optimum results.

The requirements as regards gear-ratios are entirely opposed as between the starter and the dynamo, and it becomes necessary to increase the dimensions of the machine to enable it to deliver the required torque at a gear-ratio which will not cause it to be overdriven when the engine is running at its extreme rate of revolution. It is usual to connect the armature of the dynamotor to the crankshaft at a ratio of about 2:1 or 2.25:1, the drive being by a silent chain, which may also operate the camshaft.

Dynamotors built into the flywheel have been used to a considerable extent, but it is probable that the comparatively high cost of this system will militate against its general adoption, although it offers a very attractive solution of an awkward problem. When the engine is being turned at a good starting speed there is little to choose between the dynamotor and ordinary starting motor as regards current consumption. Where the dynamotor fails, however, is at the instant of switching on with a stiff engine, for the torque then available at the crankshaft is smaller, although the current is lower. The battery output at low temperatures is of very real importance in connection with the dynamotor, in view of the comparatively low stalling torque and heavy current of this machine.

The battery is generally regarded, rather unjustly, as the weak link in the electric system of the automobile. It is quite certain that nine-tenths of the troubles experienced with batteries are due to two causes: they are seldom large enough for the duty they have to perform, and they are not properly cared for.

A feature of the accumulator that is not very widely understood is the change in apparent capacity with temperature. The highest temperature at which it is advisable to work a battery is about 40 deg. C. (104 deg. F.), and thence downwards the apparent capacity falls in accordance with a straight-line law until at minus 43 deg. C. the battery becomes inert. Consideration will explain why on cold mornings electric starters sometimes fail to function without help from the starting handle. The application of heat to the starter battery is almost as important as to the engine itself.

Regarding automobile lamps, the author is strongly of the opinion that side lights should be provided with frosted or other non-dazzling glass or reflectors, as bright side lights may be quite dangerous in busy towns, where head lights should be entirely forbidden. By properly setting the head lamps much could be done to reduce dazzle and the illumination of number plates is frequently very feeble. The use of spot-lights while a car is travelling should be prohibited, except one on the near side directed steeply downward towards the side of the road. The dimming-switch, which is a doubtful blessing, should have a definite stop position, as it is most annoying for the driver to have to feel for the right degree of dimness on each occasion of using the device. Dipping-gear for the head lights is preferable to dimming.

Purely from the point of view of efficiency of ignition there is no doubt that a well-designed coil set will give as good running as will a magneto under all ordinary conditions of operation, and usually starting will be easier and dead-slow running superior. On the other hand, a good magneto may continue to fire dirty plugs which might misfire at high speeds with a coil; moreover, if a magneto can be turned fast enough or be fitted with an impulse-starter, it may give better starting with dirty plugs. At the highest possible engine speeds success with either system is merely a matter of suitable design and good workmanship. The risk of the ignition switch being left on with the engine stopped and the contact-breaker closed, thereby, perhaps, damaging the coil or at least entirely discharging the battery, can be guarded against in more than one way, but is more fancied than real.

For motor cycles and quite small cars the combined dynamo and magneto solves the problem of providing two mountings and drives, and the system appears likely to become popular where price and dimensions are important considerations.

While the modern lighting and starting set, like the ignition gear, is on the whole satisfactory, there is room for considerable improvement in certain respects. In detail design and in workmanship some makes are more than a little lacking in perfection, and careful attention to apparently trivial matters would make such sets much more reliable. Many troubles are due to faulty installation, and particularly to careless wiring and the use of poor materials, for which the car builder must be held responsible.

Future developments of lighting and starting sets must depend very largely upon the battery, but designers of engines could do much to help the manufacturer of the electrical equipment by accepting standard patterns, and particularly by consultation at an early stage in the design. The purchasing department can also be of service to all concerned by being a little less anxious to buy at the lowest price, irrespective of technical considerations.

The paper was illustrated with a number of curves and reproduced photographs. An appendix contained a list of standard specifications connected with the electrical equipment of motor cars.

In Darkest Pressland.—The fatuousness of the observations of the lay Press upon matters electrical seems to thrive and develop constantly as time goes on, notwithstanding the increased facilities for technical education that are continually being provided.

In commenting upon a temporary failure of light in a West London suburb recently the *Sunday Pictorial*, doubtless realising that illumination, intellectual if not physical, was a prime necessity of the situation, emitted the following coruscation, the brilliancy of which can scarcely have been surpassed by the event described: "The failure of the current is stated to have been due to the fusing of wires in a high-speed manhole."

Even in an age of which it has been frequently, and not without justice, remarked that its chief characteristic is a feverish rushing about from place to place, it is a little surprising to find that so stationary an object as a manhole should develop high-speed proclivities, though on occasion we have known lids thereof to travel rapidly and unexpectedly in a short parabolic orbit. Apart from the promotion of the gaiety of nations, the moral seems to be that there are more subjects than one under the sun as to which some revision of long-held views may become necessary.

Trans-Atlantic Radio Telephony.

Broadcast Matter Successfully Re-radiated.

As was briefly pointed out in our last issue, world radio-broadcasting was accomplished, after several months of experimental work, early last month, by the Westinghouse Electrical and Manufacturing Co., U.S.A., in co-operation with its associated firm in this country, the Metropolitan-Vickers Electrical Co., Ltd. Radiated from America across the Atlantic Ocean, the messages are received near Manchester and, after being amplified to some extent, are re-broadcast in England, while the Westinghouse relay station (KFKX) at Hastings, Nebraska, repeats the programmes in the U.S.A. to ensure the reception of the messages throughout all North and South America. It is thus highly probable that the programmes are being heard all over the world; and the following account of the experiments (by Mr. R. Connor, of the Research Department of the Metropolitan-Vickers Co.) may help to dispel some of the confusion of the statements that have been made regarding them.

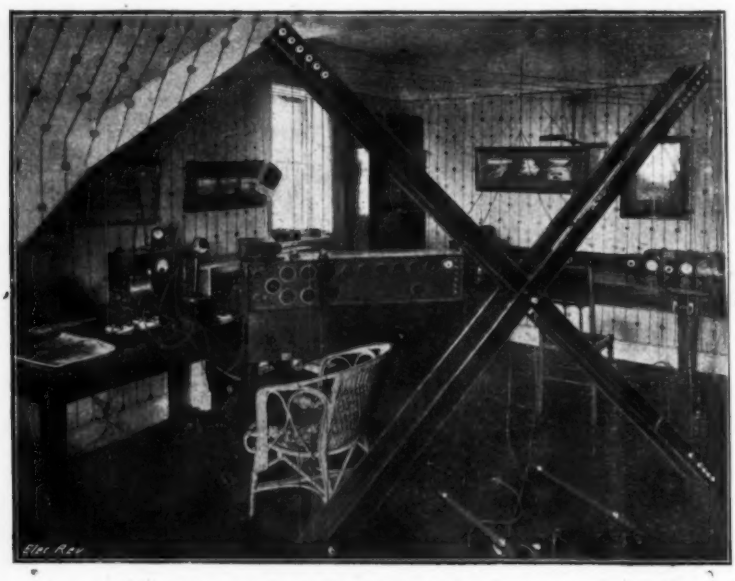


Fig. 1.—The Hale Receiving Apparatus.

The feat of re-radiating radio signals from another station is not altogether a recent one, for as long ago as February of last year parts of the programmes from the London (2LO) and Birmingham (5IT) stations of the British Broadcasting Co., Ltd., were re-radiated from the Trafford Park station (2ZY) of the Metropolitan Vickers Co., which station was then giving a nightly service on behalf of the B.B.C. Immediately after that a regular feature of the nightly programme from 2ZY was the re-radiation of the time signal from the Eiffel Tower (FL) and therefore, it will be realised that the recent experimental re-radiation of transatlantic telephony is the logical outcome of the accomplishments mentioned above, and was commenced early in October. From then onwards a great deal has been done by both companies, and the resultant exchange of information enabled successful re-radiation of signals from (KDKA) Pittsburgh to be accomplished before the end of last year.

The Pittsburgh Transmitting Station.

KDKA, the American transmitting station, is the world's pioneer broadcasting station, having been inaugurated on November 5th, 1920, by the Westinghouse Co., which also established other stations at Newark, New Jersey (WJZ), Springfield, Mass. (WBZ) and Chicago, Ill. (KYW). More recently it erected KFKX at Hastings, Nebraska (the first of its kind in the U.S.A.) to act as a repeating station and serve (from KDKA, the parent station) listeners on the Pacific Coast. Originally the power of KDKA was 100 watts, but it was increased to 500, and later to 1,000 watts. Now it is one of the most powerful stations in the world, specially designed for transmitting across the Atlantic with a view to re-radiation in Great Britain. For the recent experiments its output was 7 kW, corresponding to an input of nearly 30 kW, though it should be noted that the maximum power was not employed. The maximum output is probably greater than the combined power of all the B.B.C. stations.

In the transmitting room are three panels; the rectifier, the modulator, and the oscillator. Special tungsten valves are used, and an elaborate water-cooling system is employed on the anodes of the valves. For reasons which will be explained later the wavelength which the station worked on for the purposes of the experiment was 100 metres (it also transmits on 326 metres). One of the difficulties attendant upon this very-high-frequency transmission is that every precaution must be taken against any change of frequency due to vibration, swinging of antenna system, &c., the slightest variation in capacity, caused by vibration of the antenna system and high-frequency connections, or even movement of operators in the transmitting room, being sufficient to eliminate the possibility of intelligible reception over really long distances; hence, in the design of the station the utmost care was taken to prevent any such happenings during transmission. The set itself is suspended on a system of springs, so that vibration of the building may not affect it and the various inductances are wound on rigid formers.

The main studio, half a mile distant from the transmitting room, is similar to the studios in this country and an idea of the service can be gathered from the fact that in the centre of the city, 14 miles away, are two other studios, while the main studio is also fed by 45 land lines covering an area of 250 sq. miles and including every theatre, church, and auditorium of any pretensions in that area.

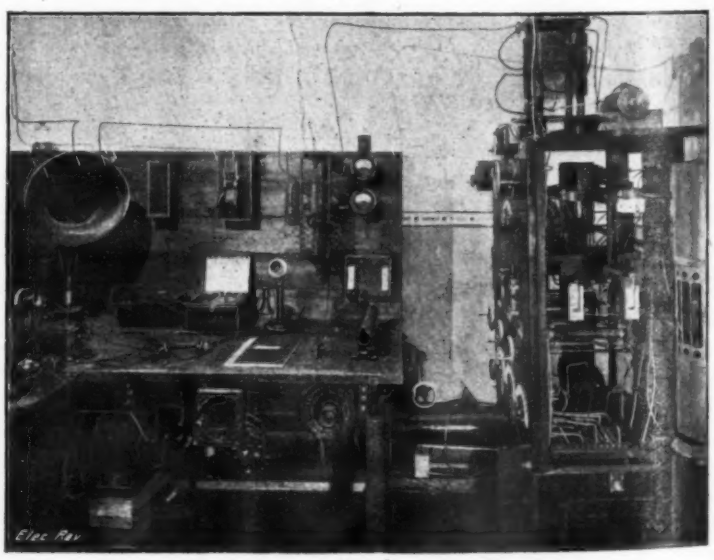


Fig. 2.—Trafford Park Re-radiating Plant.

The Hale Receiving Station.

The receiving apparatus in this country was situated at the Hale, Altrincham, station of the Metropolitan-Vickers Co., and was specially designed for 100-metre work. A frame

aerial was employed to obtain directional effect, and thus eliminate interference from other stations and reduce the effect of atmospherics which have direction. The receiver itself employed ten stages of radio-frequency amplification, though all of them were seldom employed, efficient reception being accomplished with usually four or five stages. Two stages of low-frequency amplification were used and the signals were then conveyed by land line to the transmitting station at Trafford Park.

Fig. 1 is a view of the frame aerial, receiving apparatus, and control equipment used at Hale.

The Trafford Park Re-radiating Station.

The re-radiating station (2AC) is located in the Metropolitan-Vickers works and is equipped with purely experimental plant, which is illustrated in fig. 2. The set is supplied with power somewhat smaller than that of the British broadcasting stations, the latter being 1.5 kW. The transmitting aerial, fig. 3, is the one which was used when broadcasting first took place at Trafford Park, and is one of the cage variety, the re-radiation taking place on a wavelength of 400 metres.

Some Difficulties Encountered.

When the experiments commenced early in October, 1923, the principle troubles encountered were the result of atmospherics, fading, and distortion. Reception in this country of American broadcasting on 300/500 metres, with even very simple receivers, has been quite common, but extremely irregular, and does not take place nightly over periods of weeks, the average number of hours' reception being very small. Furthermore, quality of speech and music is variable, and only on rare occasions are good results obtained. By good results is meant intelligible speech and music of sufficiently good quality to be re-radiated.

It is also characteristic of this reception that the earlier part of the programmes is not usually received; then matter

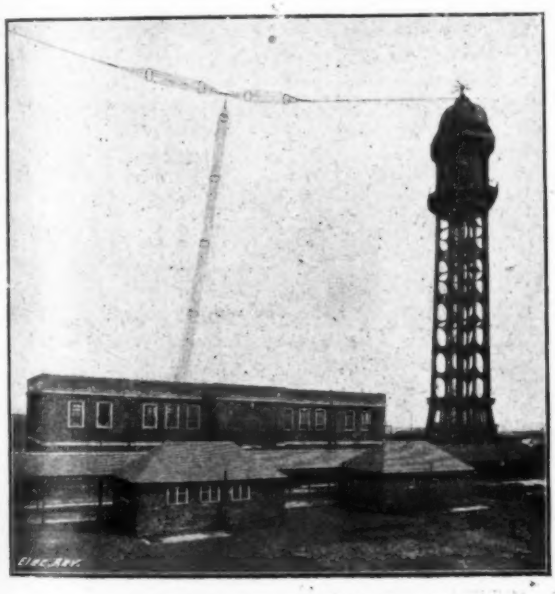


Fig. 3.—The 2AC Transmitting Aerial

comes through very well at about 1 a.m. to 3 a.m G.m.t. A curve of signal strength against time shows a decided peak. The preliminary experiments confirmed the above general experience, and also showed that fading was very bad. It was found, however, that when working on a wavelength of less than 150 metres fading was not nearly so pronounced; also satisfactory reception could be accomplished well before midnight. For these reasons and also the fact that interference from other stations is less on such wavelengths, it was decided to use 100-metre transmission from KDKA and not the normal 326 metres. Another point in favour of the 100-metre transmission is that it came through quite well at the commencement of the programme at 6 o'clock e.s.t., *i.e.*, 11 o'clock Greenwich time. The amount of extremely good reception that took place sometimes between 4 and 7 o'clock in the morning (G.m.t.) when special tests were being made after the conclusion of the Pittsburgh evening programme, was remarkable.

Distortion was at first very bad and speech was practically unintelligible, but daily tests and close co-operation between Trafford Park and Pittsburgh resulted in sufficient improvement being effected at both places, combined with a further increase in power at KDKA, to enable re-radiation to be carried out from December 27th for over a week, though before re-radiation was accomplished some work had to be done due to the fact that the further increase in power again introduced distortion. It should be noted that the original very bad distortion was due to several causes, principally wavelength change and "night distortion." An exceedingly minute change of wavelength is very serious in this respect. On the first two nights re-radiation of KDKA was also effected by the B.B.C., which had been conducting experiments at Biggin Hill and used KDKA's transmission for the purpose.

Much remains to be done, particularly with regard to overcoming adverse atmospheric conditions, but what has been accomplished shows that the advent of everyday transoceanic radio telephony, without the use of exorbitant power, is considerably nearer realisation. The reception on 100 metres of KDKA and re-radiation is no freak.

Legal.

Evans v. Central Electric Supply Co., Ltd. Film Cooling Towers v. Evans.

ACTIONS OVER PATENT RIGHTS.

IN the Chancery Division, on January 21st, 22nd and 23rd, Mr. Justice Astbury tried an action by Film Cooling Towers, Ltd., of Chancery Lane, against Athol Gerald Evans, of Churchfield Avenue, North Finchley, for a declaration that the defendant held letters patent (10,369) relating to improvements in water cooling towers for use with steam plant, as trustee for the plaintiffs; for an Order on the defendant that he assign the letters patent to the plaintiffs; alternatively for a declaration that the plaintiffs were licensees of the defendant under the patent; and for an injunction restraining the defendant from threatening customers of the plaintiffs with legal proceedings or liability in respect of alleged infringement of the patent.

Another action, by Mr. Evans against the Central Electric Supply Co., was down for hearing in front of the Film Cooling Towers action, but it was arranged to try the latter first.

Mr. LUXMOORE, with whom was Mr. Moritz, said the action by Evans against the Central Electric Co. was for alleged infringement of a patent for a water cooling tower. Such a tower was erected for the Central Electric Co. by the Film Cooling Towers, Ltd. In the action by the latter company it claimed against Mr. Evans that the patent, in fact, belonged to, and that he was trustee for them. If the company succeeded in that claim there was an end of the Evans action, and if it failed, then he said it also failed in the Evans action.

Opening the action by the Film Cooling Towers Co., Counsel said that it was founded on this: that the defendant Evans was the servant of the plaintiffs and that during his employment he took out a patent for this particular invention; and plaintiffs said that the terms of his employment were such that he was bound to hold it as trustee of the plaintiffs, and it would be a breach of his duty to claim the patent for himself. For some time prior to February, 1916, the defendant was in the employ of the plaintiffs as an engineer and manager. It was part of his duty to make drawings for the construction of cooling towers, to devise improvements, and to superintend the making of such drawings and the devising of such improvements by other draughtsmen in the employ of the plaintiffs. All such improvements became by virtue of such employment the property of the plaintiffs, who were entitled to the benefit of the same. In January, 1916, one Holland (a draughtsman in the employ of the plaintiffs) was engaged in devising improvements for cooling towers, and worked out a method of construction which was afterwards embodied in the specification of the letters patent in question. Alternatively such improvement was worked out by Mr. Holland under the supervision of the defendant in the ordinary course of the defendant's duty or the improvement was devised by the defendant with the assistance of Holland in the ordinary course of Holland's and the defendant's duty in the time of and with the materials of the plaintiffs. The improvement was and remained the sole property of the plaintiffs. The defendant, in breach of his duty to the plaintiffs, on February 5th, 1916, applied for and eventually obtained, in his own name, the letters patent in respect of the improvement mentioned. On August 31st, 1919, the plaintiffs and the defendant entered into an agreement of service which provided for the working by the plaintiffs as licensees of any invention in which the defendant was at that date or might thereafter become the patentee, upon terms contained in the agreement. In 1917, the defendant was summarily dismissed by the plaintiffs. At a date subsequent to the dismissal the plaintiffs erected a tower for the Central Electric Supply Co., Ltd., at St. John's Wood. The defendant then alleged that the construction of the tower constituted an infringement of the patent granted to him, and he further threatened the Central Electric Co. with an action for infringement of the patent, and such an action was, in fact, now pending. In his defence the defendant said that he was the registered legal owner of the patent. He denied that the application for the patent was in breach of any duty owed by him to the plaintiffs, and he also denied that any improvement embodied in the specification was devised by him either in the time or with the materials of the plaintiffs or in the ordinary course of any

duty that he owed to the plaintiffs, or with the assistance of Holland. In any event he denied that any such improvement became, either by virtue of the employment or at all, the property of the plaintiffs, or that the plaintiffs were at any time entitled to any benefit or had any property or rights therein. In January, 1917, it was verbally agreed between the plaintiffs and the defendant at interviews between him and Mr. Clemow and Mr. White, directors of the plaintiff company, that defendant should be employed as manager of the plaintiff company for a period of three years at an increased salary and commission, and in consideration thereof the plaintiffs should, during the continuance of his employment, have a right to use in connection with the erection of water-cooling towers any invention of which defendant then was the patentee. He denied that he entered into any agreement for the working by the plaintiffs as licensees or at all of any invention of which he was the patentee. In breach of their agreement the plaintiffs wrongfully, by letter of November 22nd, 1917, summarily dismissed the defendant and thereby repudiated the agreement.

Evidence in support of the plaintiffs' case was given by Walter Wm. White, Harold A. Holland, Fredk. A. Caley, E. A. Crisp, and G. E. Hodgkinson.

Mr. Whitehead, K.C., and Mr. A. Cecil Caporn, were counsel for the defendant, and evidence was given in support of his case by defendant himself.

At the close of Mr. Evans's evidence

His LORDSHIP said he had now heard both sides, and he suggested that some sensible accommodation should be come to with regard to both actions.

Counsel consulted their clients, and subsequently Mr. LUXMOORE announced that they had come to terms, which would put an end to the whole of the litigation. Mr. Evans would assign the patent to the plaintiffs as from the date that he left their service and they would pay him the sum of £50 to cover the expense he had been put to with regard to the patent, and each party would bear its own costs.

His LORDSHIP said he was pleased to hear that the parties had come to terms, and he desired to say that as far as any charge was implied against Mr. Evans, in his opinion it had not been proved.

Berry's Electric, Ltd., v. Bull.

IN this action, which came before Sir Edward Pollock, High Court Official Referee, on January 24th, the plaintiffs clamed from Mr. W. Perkins Bull, of Somerset Road, Wimbledon, the sum of £346, balance of account of £696 for goods sold and delivered.

On the case being called counsel for the plaintiffs said that a difficulty had arisen owing to a mistake on the part of his professional client as to the state of the list, and as a result he was not prepared for trial.

Mr. PRITT, appearing for the defendant, said that Mr. Bull was a gentleman who had large interests in Cuba, and having arranged to go to Canada he would have to be away for some little time. It was therefore difficult to make an arrangement by which a date for the trial could be fixed. He was now prepared with witnesses for the defence, and ready to proceed.

In the course of a conversation which followed, plaintiffs' counsel said that the hearing would probably occupy two or three days, and the Referee observed that in the circumstances the case would stand over for the convenience of the defendant, and the plaintiffs would have to pay the costs of the adjournment.

It was ultimately arranged that the hearing should be fixed for June 17th.

Evans v. Benyon.

AT the Blackpool County Court, on January 23rd, William Evans, "Glendoon," Reads Avenue, Blackpool, sued Charles Benyon, Wolverton Avenue, Blackpool, to recover £64 for work done.

WM. EVANS, an electrical engineer, said that in November, 1922, Benyon accepted his offer to fit up a house which he was building in Wolverton Avenue with electric light. The work was completed in July, 1923. When he sent in the bill, Benyon complained of the price. The bill was for £82, and he had received £18 on account.

CHARLES BENYON, a consulting electrical engineer, said the lighting had not been a success. The job should have cost £30, the bells £5, and heating £10, making a total of £45.

His HONOUR said what ought to be charged was £61 17s. 6d., instead of a total of £82. As £18 had been paid on account, he gave judgment for £43 17s. and costs.

Briggs v. Wuest and Reid.

IN the Court of Appeal in Dublin last week, before Mr. Justice SAMUELS, an appeal was heard in this case, which was brought from a decision of the Recorder of Dublin, the defendants being the appellants.

The action was brought to recover £17 balance of £34, the amount of a contract for the electric wiring of the residence, 53, Leinster Road, Dublin, of which Wuest was the tenant and Reid the landlord. The latter had paid £17, which, he alleged, was the amount of his liability in the matter, the other £17 being due by the tenant Wuest.

The RECORDER had given a decree for this £17 against Wuest, and dismissed the action against the landlord, Reid.

Mr. Justice SAMUELS now reversed the Recorder's decision, and gave a decree for £17 against Reid, and dismissed the action against Wuest.

British Thomson-Houston Co., Ltd., v. Braham.

IN the Chancery Division, on January 22nd, Mr. Justice Russell granted an injunction to the plaintiffs restraining Mr. John Braham, of 194 and 196, Bishopsgate, from passing off head 'phones as the plaintiffs' by describing them as "Thomson-Houston."

Mr. TREVOR WATSON, for the plaintiffs, explained that these were head 'phones for use with wireless apparatus. Defendant was prepared to give an undertaking in the terms asked for, subject to an inquiry as to damages, and to pay the costs, taxed or agreed. If the damages could be agreed, the amount would be put in the order, and if a sum was agreed, the inquiry, of course, would be obviated.

Igranic Electric Co., Ltd., v. Delfosse.

MR. JUSTICE RUSSELL, in the Chancery Division on January 22nd, heard a motion by plaintiffs for an injunction restraining Mr. E. J. Delfosse, who trades as the Osmond Engineering Co. at Pentonville Road, from infringing a patent for filament resistance rheostats.

Stating the case of the applicants, Mr. MOWL said the patent was numbered 195,903, and plaintiffs alleged infringement by manufacture and sale, and advertisement in a wireless paper.

The defendant admitted the sale of 341 rheostats, and admitted publication. He offered to give an undertaking not further to infringe and to pay £50 into Court as damages and to deliver up the infringing articles.

His LORDSHIP granted an injunction in the terms asked for.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

MR. JUSTICE RUSSELL, in the Chancery Division, on Monday, January 28th, gave judgment in this action, the hearing of which occupied several days during last term. In the action the plaintiffs sued the defendants for infringement of letters patent, and claimed an injunction and other usual relief. Defendants denied infringement on several grounds, counterclaiming for revocation.

His LORDSHIP said he was satisfied that plaintiffs by their process had solved a problem which had hitherto been unsolved, and that the process disclosed by the 1906 patent was unworkable. The grounds of defence set up had failed. In the result he held that the plaintiffs were entitled to the relief they claimed—an injunction to restrain and an inquiry as to damages with an order to deliver up. The counterclaim would be dismissed with costs.

Heavy Oil Engine Working Costs.—In the hon. secretary's report for 1923 of the Diesel Engine Users' Association reference is made to the important work carried out during the year in connection with the report on heavy-oil engine working costs, which has been prepared by the General Committee, and the hope is expressed that in future returns from a larger number of installations might be available. The average working cost of a representative group of heavy-oil engine installations working with an annual plant load factor of at least 15 per cent., and with outputs approaching one million kWh per annum each, was 1.086d. for 1921, and if a suitable correction were made on the basis of present-day prices of labour and material that figure, as at March, 1923, would be .789d. per kWh. The report showed fuel oil cost variation for several undertakings over a period of five years. The cost of oil fuel per kWh generated in 1921 was .53d., and that cost had practically adjusted itself to the figure obtaining in 1917 (.52d.) before the occurrence of abnormal conditions consequent on the war. Average figures of the quantity of fuel oil consumed per kWh generated are of special interest in showing the effect of the use of tar oil in place of petroleum fuel oil during the period covered by the war. In 1921 the average figure for fuel oil consumption was .67 lb. per kWh generated. The report also dealt with the working costs of certain installations in India. The Committee considered the form in which the report on fuel consumption and energy generated at electricity undertakings throughout the country was issued by the Electricity Commissioners. It was felt that in some respects the information would be more generally useful, and would give a more correct impression of the results obtained by the use of heavy-oil engines, if the returns could be made in a somewhat different form. The Electricity Commissioners were communicated with, and it was understood that the form in which the results of the working of heavy-oil engine installations would be put forward in subsequent reports would be amended to some extent.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Reavell "Sub-station" Compressor.

In our issue of January 10th, 1908, we described a rotary-type blower for cleaning electrical plant and machinery made by MESSRS. REAVELL & CO., LTD., Ranelagh Works, Ipswich. The firm has now produced an improved type, the advantages of which include smaller weight and higher speed. The new compressor is directly coupled to a motor running at a speed of about 1,440 r.p.m., designed to suit the supply of the station in which it is to be used. The compressor gives a pressure of about 20 lb. per sq. in., and has an actual delivery of just over 8 cu. ft. of free air per minute at this pressure. The plant is fitted with a pressure gauge and relief valve,

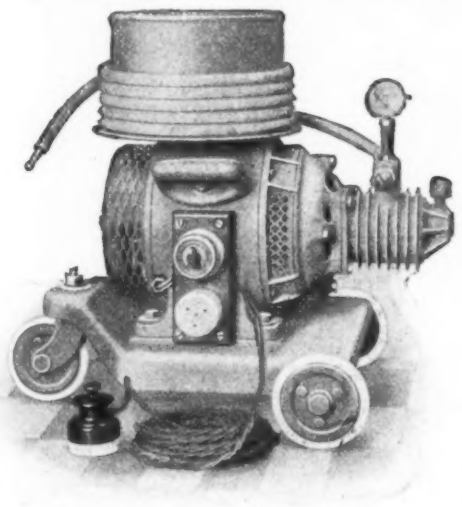


FIG. 1.—THE REAVELL "SUB-STATION" COMPRESSOR.

30 ft. of flexible cable with a suitable wall plug, and 15 ft. of flexible hose with a suitably-proportioned nozzle. As will be seen from fig. 1, a steel drum for carrying the flexible hose and cable is fixed on the top of the motor. The equipment has overall dimensions of 2 ft., by 1 ft. 5 in., by 1 ft. 9 in., and, complete with wheels, weighs only 150 lb. The wheeled truck can be omitted if desired. Since the earlier set was introduced orders for it have been received from many important electricity undertakings and collieries, as well as other power users at home and abroad.

An Electrically-operated Tire Pump.

Of interest to motor car garage proprietors is the David portable tire pump recently put on the market by Messrs. WILLIAMS & JAMES, of Chequers Bridge, Gloucester. The pump, which is mounted on a small trolley, comprises a twin-cylinder air compressor and an electric motor directly connected thereto. The compressed air, after passing through a combined cooler and filter, is delivered to the tires by 18 ft. of tubing carried on a drum and fitted with a pressure gauge and a release valve which can be set to operate at any desired pressure up to 150 lb. per sq. in. The outfit can be supplied for any voltage and for either a.c. or d.c., and will, it is claimed, fully inflate four ordinary car tires in as many minutes.

A Hack Saw for Armoured Cables.

The production of a hack saw for cutting through armoured cable presents a difficult problem, but it has been solved by MESSRS. FRY'S (LONDON), LTD., 46, Upper Thames Street, E.C.4, in their "Enox Flex" blade. This is very flexible, the teeth only being hardened, and it is said to cut cleanly through steel-taped cables. This should commend it to mains engineers and others who have to deal with this class of cable. The saw is made with 16, 18, 22, or 32 teeth per inch.

The One-Volt Ora Valve.

One of the latest products of the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, S.W. 12, is a low-temperature, 1-volt Ora valve for use with dry cells, and it is claimed that one dry cell will continue to operate such a valve even after its voltage has fallen considerably below one volt. The overall length of the new valve is 4 in. and its diameter 1¼ in., while it has the ordinary 4-pin base. It will function with an anode voltage of from 30 to 150 V, according to whether it is used as a detector or h.f. or l.f. amplifier, and its filament voltage and current are respectively one volt and 0.25 A (0.25 watt). The total emission is approximately 6 mA, the maximum amplification factor 11, and the normal working slope 0.25 mA-volt.

Correspondence.

***Correspondents should forward their communications* at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

A Safety Device for Electric Kettles.

We notice that on page 108 of your issue dated January 18th, under the heading of "Institution of Electrical Engineers," Mr. E. E. Sharp criticised the design of electric kettles, and asked for a safety device to prevent them burning dry.

We have much pleasure in stating that the "Universal" electric kettle is equipped with the "Universal" patented fuse plug which automatically breaks the circuit should the appliance be boiled dry and left connected. It is a device that has been tried and tested by many of the most important engineers throughout the world, and recognised as a satisfactory protection. Any housewife could replace this fusible plug in a matter of two or three minutes.

Because this safety fuse is fitted not only to the "Universal" electric kettles but also to coffee percolators, teapots, water and milk heaters, and most other "Universal" liquid heaters, a very comprehensive guarantee is given, which is very liberally adhered to by the manufacturers.

A sample of the actual fuse plug will be sent to any of your readers on request.

We are told by electricity authorities who hire out "Universal" kettles fitted with the safety fuse, that it has entirely done away with their maintenance charges on kettles that they let out on hire, and the small extra initial cost of the device is overcome in a very short period.

L. G. Hawkins & Co., Ltd.
L. G. HAWKINS.

London, *January 22nd*, 1924.

Two-way Pendant Switch Flexibles.

We are very interested in "Safety First's" letter on the above subject in your issue of the 25th instant, particularly as in 35 years' acquaintance with two-way wiring we have never heard of trouble occurring if the circuit be wired in the correct manner, *viz.*, that in which one pole only is connected with the switches.

Apart from the question of imperfect triple flexible, if lamps are wired on the principle first advocated in the U.S.A., *viz.*, *both* poles connected with each switch, trouble will most likely occur either from inefficient insulation, or short gaps in the switches when changing over.

Perhaps the cause of "Safety First's" trouble may be the unfortunate adoption of this faulty two-pole method, otherwise we cannot see how "shorting" and subsequent ignition can occur, as he states, if both poles are not present.

We have all along emphasised the trouble likely to occur by adoption of this defective method in most of our references to "two-way" and "two-way intermediate" wiring.

A. P. Lundberg & Sons.

London, *January 25th*, 1924.

[The circuits in question are illustrated in Messrs. Lundberg's "Lektrik Lighting Connections," 7th edition, pp. 57-69; the objectionable connection referred to above is shown, and duly condemned, on p. 64. The Saxonia Electrical Wire Co., Ltd., informs us that it makes three-way flexibles.—EDS. ELEC. REV.]

The Training of Apprentices in Evening Schools.

The article by Mr. R. C. Wood in your issue of the 18th inst. comes at a very opportune time, and merits the careful consideration of the new Education Minister.

It is unfortunate that the great majority of principals and teachers in technical institutes consider practical work, and the direct application of theory to practice, as being an inferior grade of instruction, and rather beneath their dignity.

It can be said that while students are encouraged to think of engineering as a purely theoretical subject, and are taught that the sooner they can get out of the workshop the better, the present state of things will continue.

Teaching the calculus to young men who cannot be relied upon to work out a simple practical mathematical problem, or giving a smattering of higher electrical calculations to a switchboard attendant, may be educational and may meet with the approval of the education authorities, but its value in the works, in 99 per cent. of cases, is *nil*.

It is impossible for anyone with modern works experience to disagree with the conclusions of Mr. Wood, and I do not think it would be possible to find a technical institute in the United Kingdom where craftsmanship or practical instruction is considered of primary importance.

The chief reason for the lack of practical training (both hand and brain) is the attitude of educational authorities towards this type of work. They consider the purely academic teacher to be superior in every way to the one who has been through the shops, and emphasise the difference by giving him a higher scale of salary; for that reason alone it would be foolish to expect a teacher to attempt what is considered to be a lower class of work.

The apprentice, owing to modern conditions, does not get

anything like the training he received a few years back, and although this could be overcome to a very large extent by suitable tuition in the technical institute, it is hardly likely that anything will be done until the distinction between the academic side and the practical side of teaching is removed.

When principals are compelled to realise that the great majority of the students attending their institutes are artisans, and will remain artisans for the rest of their lives, it is possible that some alteration will take place, but while all the dignity is taken away from labour and concentrated on higher education, little progress will be made in the direction indicated by Mr. Wood.

The idea that all students are potential managers is ridiculous; far better that exceptional students be sent to higher-grade institutes, and thus allow the work to be carried on at the level it should be.

Teachers frequently argue that the application of theory to practice should take place in the works, and while the powers-that-be wish the present system of teaching to continue that argument will always be forthcoming.

The only remedy for the present state of things is for educational authorities to cut out the fetish of the first-class honours degree for teachers, and to encourage practical teaching by giving practical teachers the same status that is given to the purely academic staff.

M.I.Mech.E.

January 25th, 1924.

Printing Telegraph Systems and Mechanisms.

Mr. Harrison, in his letter of December 31st last, dealing with the review of his book in these columns, explains his reference to the Hughes apparatus by stating that he did not deal with the question from the British standpoint alone; as, however, most of his illustrations referred to the design as used by the British Post Office, and as there is a considerable difference in the mechanical details of the Hughes as used in this country and on the Continent, it was reasonable to assume that his treatment was chiefly concerned with the former.

With regard to the Baudot correction, Mr. Harrison's corrected statement that "the speed is not exactly reduced to zero" may be allowed to pass; but it is very different from the statement that the brushes "are momentarily stopped."

In his letter he uses the expressions : (*a*) "When the star-wheel is freed," (*b*) "the driving effort on the brush arms is zero," (*c*) "brushes to be carried forward when unlocked." These three statements are wrong, as he will find if he can borrow an instrument and turn it very slowly by hand. There is no mystery about it. The star-wheel is never freed, nor unlocked; the driving effort on the brush arms is always there when the instrument is running with or without correction taking place. When correction is acting it merely lowers the gear of the driving effort without removing it.

It is quite agreed that leakance will reduce the speed of working, and that very considerably too, under certain conditions, and the telegraph engineers in this country are by no means ignorant of the fact, but such a general statement as that "leakance has the effect of reducing the transmission speed on land lines" requires amplification. Lastly, in regard to the Baudot duplex, Baudot himself suggested single channel Baudot duplex in 1882 and it was so used by the French Administration from 1883 until 1887; then a double duplex was used by the same administration from 1892 till 1900. This surely is "achievement" and not "suggestion." Pollock and Rowlands used the duplex too, but had to shut down because of the inherent disadvantages of the codes. Briefly, all duplex multiplex trials had failed to justify their existence and the majority of efforts were concentrated on high-speed automatic systems. While not accrediting to Booth the combination of duplex balance with multiplex, it is certainly claimed, and considered to be clear of any reasonable objection, that his was the first continuously successful quadruple duplex multiplex obtained by the combination of the duplex balance with the Baudot five-unit alphabet, and as a result of that success there has been an almost complete turn round from high-speed automatic to duplex multiplex with the five-unit code, which is having a world-wide application. Herein lies the value of Booth's achievement. Without his success the world of telegraphs would probably have been still struggling with the practical difficulties of the high-speed automatic systems.

The Reviewer.

January 25th, 1924.

What is a Megger?

With reference to the letter which appeared in your issue dated January 18th, from Mr. Sydney Evershed, I am glad to think that his wrath does not fall upon my devoted head—directly, for my thoughtless oversight in putting in writing precisely what one of the speakers said at the Paris E.H.P. Transmission Conference. Possibly I escape inclusion with the Editor in any action for libel, because Mr. Evershed knows more about the law than I do. For, reading between the lines of his letter, evidently an editor has to bear the brunt of any libels created by his contributors. Anyhow, I tender my apologies, and, to make amends, I put the query at the head of this letter—What is a Megger? This should do some good, for I doubt whether as many as 10 per cent.—nay, five per cent.—of electrical men really know. Hence this educational categorical query. (Gentle reader, *you* know, of course, but just ask this question of the next ten electrical men you meet; you will be amused at their struggles to reply.) I do not suppose it is news to Mr. Evershed to hear that the Megger (should it have a capital "M" or a small "m"?) is one of those things that are taken for granted. I can almost imagine the makers saying, "You turn the handle and we do the rest." And the insulation resistance of the human mind (to quote Mr. Evershed) is such that it will not even trouble to turn up I.E.E. papers of a decade or more ago to ascertain its main principle of operation—certainly it would not trouble to look in American (or Barcelona) journals for that information.

Apparently I have forestalled Mr. Evershed, for I now keep pigs (which keep me), only I run them more along the lines of Megger development, than according to the methods of his ancestors, with proportionately good financial results. However, my output is infinitely less than that of Meggers, being only about 365 per annum. Incidentally, they are the least electrified things on my farm—their insulation resistance is apparently too great.

R. Borlase Matthews.

East Grinstead, *January 25th*, 1924.

E.h.p. Transmission Lines.

I have not had an opportunity of ascertaining and summing up the total mileage of high-pressure and e.h.p. lines at present in this country, but I know that it now amounts to a very considerable figure. The operating data, however, that are available for the conditions that exist in this country are very scanty, hence such a letter as that which your correspondent contributed under the *nom-de-plume* of "Pelican" is of special interest. It is to be hoped that others of your readers will follow suit and give of their experiences. Undoubtedly, during the next ten years a great deal of overhead work (some tens of thousands of miles) will have to be done in this country, especially in connection with rural supplies. Owing to the considerable experience with underground cables in this country, I think that many of the sub-distributors at about 10,000 volts will be cables, as the sub-station costs can probably be reduced below those of sub-stations for aerial lines at that pressure. The low-voltage distribution lines will probably be overhead, and likewise the e.h.p. lines feeding the 10,000-volt sub-distributors—but it is always dangerous to prophesy.

I thank your correspondent for his kindly recognition of my efforts in dealing with the subject.

R. Borlase Matthews.

East Grinstead, *January 25th*, 1924.

The Quantum Theory.

"Facts *are* Fancies" does not quote me quite correctly; but the point is not great. What is of more importance is the fact that, in his example of "the chair in which I sit," he is confounding *existence* with *knowledge of existence*; and he had better read Karl Pearson's "Grammar of Science." A paper on "Sensation and Thought," read before the Aristotelian Society, a few weeks ago, might also prove helpful to your idealistic correspondent.

But let us come back to our "muttons." If "energy" means *ability to do work*, it cannot "emerge from the phantom realm of imponderables to take substance"!

Facts Before Fancies.

January 26th, 1924.

Electricity in Mining.

Having read with much interest your article on "The Position of the Colliery Engineer," and also the comments of your correspondents with regard to qualifications of "Colliery Electricians," I wish to make a few remarks about the same. Having served part of my apprenticeship to colliery electrical work, and being employed as colliery electrician at several collieries since, I quite agree with you that the engineer should be held responsible for and take full charge of the mechanical and electrical equipment of the colliery. Also that certificates, diplomas, &c., should be available for those positions. Of course there are some colliery companies which have worked on similar lines to this for years. I have worked for two large colliery companies which have had a chief and an assistant chief mechanical engineer, and a chief and assistant chief electrical engineer, who have been responsible for the mechanical and electrical equipments at the individual pits and in charge of the engineers and electricians there. But I think the engineers and electricians at the individual pits should be allowed to qualify for certificates, so that they can be responsible for the equipment at that particular pit, instead of the manager at the individual pits. It stands to reason that the manager cannot be fully competent in mechanical and electrical engineering, as well as in mining, or he would have to be a super-man. As regards the training of colliery electricians, I think they should serve part of their apprenticeship on the manufacturing side, and the latter

part at a colliery, as there is no doubt that installing gear and repairing and locating faults in a mine is of a different nature to surface work; an electrician who had never worked below before would not be quite as handy as one who had. Despite your correspondent's remarks about the reliability and absence of faults and breakdowns in modern mining gear, it is surprising what faults occur. I know that the gear is made as fool-proof as possible, but he would be rather surprised if he saw some of the coal-cutters and trailing cables after some rough handling, such as machine stuck and current left on, cable pulled out of pummel, &c. Then, again, an earth developing on a cable is a matter of urgency, which must be located at once. There is never much absence of faults, which need not be due to bad design or poor workmanship, but to the way the plant is worked. I think that an electrician in a mine gets more practice in locating faults than at any other job, and the conditions of doing so are not at all easy. Your correspondent is correct in what he says about the enginewright, who is generally a steam man holding sway over the electrical department; but it is only at small mines, where there is only a small installation. Most colliery companies owning large mines have an electrical engineer, the electrician taking his instructions from him, who should know whether the "colliery electrician" is competent or not.

Pre-War.

January 19th, 1924.

Your article under the heading "The Position of the Colliery Engineer," furnishes a long-desired explanation and should be the means of enabling colliery owners and agents to realise that it is just as necessary to have a qualified engineer, as it is to have a qualified manager, for the efficient operation of a mine.

The fact that efficiency often decides between a paying and a non-paying proposition applies to a colliery as well as to any other industry. Fortunately, at a colliery fuel is on the doorstep, and fuel economy appears to be classed, by those concerned, as a technical polariser invented by the large coal consumers to cut down the colliery output.

I would suggest a really non-technical explanation of fuel economy for the benefit of those in charge of colliery steam-raising plant, which might eventually benefit all concerned by the increase in efficiency, with its resultant decrease in coal consumption, allowing the owners to reduce the price of coal to those who really do make use of the total heat value of the products of combustion of coal, and do not try to contaminate the surrounding atmosphere with carbonic oxide. Economy in steam consumption has certainly received more consideration, due, of course, to the mixed-pressure turbine manufacturers.

This utilisation of low-pressure steam from winding engines, steam-driven compressors, &c., which was previously wasted, naturally results in economy; but, unfortunately, owing to the absence of a qualified engineer, the economy obtained in many instances rapidly disappears after the plant is handed over, due to mis-handling.

The winding engineman reports that his engine does not speed up quick enough when exhausting into the low-pressure receiver; the relief valve on the receiver is tampered with; guesswork is applied, with the result that when the winding engine is fully accelerated the exhaust steam is released to atmosphere in preference to the intended efficient route *via* the turbine, which is practically utilising live steam continuously, due to the low-pressure steam being directed from its intended economical path.

A qualified engineer would put a stop to guesswork, tampering, and diversion of heat energy from its useful channel. In the event of a colliery being placed on the list of efficiently-operated power plants further revenue might be obtained by collecting the surplus coal dust in and around the mine and classifying it as fuel already pulverised.

W. D. Wylde.

Jarrow-on-Tyne, *January 27th*, 1924.

Stress and Strain.

In your issue of the 18th inst. I notice a short reference to my recently-published primer "Electric Cranes and Hauling Machines." Your reviewer accuses me of "making the common error of confusing "stress" with "strain" (Cp. table 1, p. 69)." I would like to take this opportunity of explaining that the reason the word "strain" is adopted is simply because it is the term most generally used by rope manufacturers and crane makers in describing the strengths of ropes, and as this primer is written for the busy practical reader rather than for the academic critic I trust the privilege will be excused.

F. E. Chilton.

Westminster, *January 22nd*, 1924.

Single-phase Induction Motors and the Starting Problem.

I have read with interest the letters from your correspondents regarding my recent article, and I thank them for their criticism.

The hesitation of a single-phase motor at certain critical speeds whilst starting up, although due primarily to harmonics in its field form, is less pronounced when its rotor resistance and non-inductive starting resistance are of correct proportions. As is well known, there is for every single-phase motor a particular resistance of its rotor with which the maximum starting torque will be obtained, and it therefore sometimes happens that increasing this resistance, although reducing the starting current, will increase the starting torque.

With reference to the distributing of the winding in a greater number of slots I would point out that zig-zag leakage is greater with a larger number of stator slots; and, in my opinion, it is rather considerable during the operation of starting. Perhaps the somewhat ambiguous sentence in my article to which Mr. Hoseason has referred would have been clearer had I written: "The stator coils may be placed in more intimate relationship with the iron, resulting—whilst starting—in a higher self-induction, and consequently a greater phase lag (as well as a better power factor when running under load), by subdividing the winding among a larger number of slots." The further distributing of the starting winding amongst the running slots carries with it an additional advantage in that it ensures the magnetic polarity of the retarded phase being more nearly in its correct position with respect to the polarity of the "running" phase.

The ill-usage to which a single-phase squirrel-cage motor may be subjected at starting—to say nothing of possible overloads when running—makes it desirable that the end connections of the rotor should be fairly massive, so as to avoid overheating at this part. This leaves only the bars, in which we can embody the necessary resistance; and although the heat generated in the body of the rotor will cause a slight general increase in the temperature of the whole machine, as pointed out by Mr. Lee, this is not such a serious objection as it might appear, seeing that the iron losses in the rotor (at full load and speed) are quite small.

Fred. W. Davies.

Huddersfield, *January 26th*, 1924.

Domestic Electrical Apparatus.

It is pleasing to note your interest in my remarks, and perhaps you will kindly permit me to say that the electrical contractor does not promptly forget the existence of the wiring and fittings he has installed; on the contrary, it is our custom, and the custom of every reputable contractor, to give 12 months' guarantee with his work and apparatus.

We contend that the proper and best channel for this class of work is the contracting industry, and interference from the supply authorities, especially municipal bodies, is unnecessary. Their time and industry can be beneficially employed in producing cheap and reliable current, without vexatious restrictions or disturbance to the customer.

In view of an outside remark, and to avoid gratuitous personal advertisement, allow me to again remain,

A Northern Contractor.

January 26th, 1924.

[If the contractor can furnish such a maintenance service as we outlined, on an economically sound basis, by all means let him do it. We suggested that it would not be worth his while, but if we are mistaken in this, so much the better.

All the same, we have never heard of any electrical contractor who carries out the periodical visitation of customers that we advocated.—EDS. ELEC. REV.]

The Lesson of Fulham.

I should like to reply to "Pertinax" that "Two wrongs do not make a right." The people employed in public works have a duty to that public, and in the case under discussion that duty was quite clear, *viz.*, to keep up the supply of electrical energy. The action of the E.P.E.A. meant that the Association took the view that the wages of a very small section of the public were far more important than service to the public at large.

To me this shows quite a wrong sense of proportion. The public services exist for the public and, that being so, the E.P.E.A. should have insisted upon keeping the Fulham works running. It should be a crime for anyone to withdraw his or her services from the community as a means of extorting some advantage.

The action of the E.P.E.A. and similar cases will never lead to industrial peace.

F. L. T.

January 28th, 1924.

White Osrams for Street Lighting.—The use of white Osram gasfilled lamps for lighting main streets which was inaugurated by the Metropolitan Borough of St. Marylebone just before Christmas, has now been extended to the area of the Hampstead Borough Council, which recently ordered, through Messrs. William White & Co., a supply of 60-watt and 100-watt white Osram gasfilled lamps, which will be used in the ordinary converted gas standards for street lighting. The snow-white glareless light of the white Osram is much appreciated by travellers on fast-moving vehicles, who are relieved of all risk of dazzle, and can drive with confidence in the most crowded thoroughfares.

Co-ordination of Research in Illuminating Engineering.

A PAPER on the above subject was read by Mr. J. S. Dow, at the meeting of the Illuminating Engineering Society, on January 22nd, Mr. D. R. Wilson presiding.

In his opening remarks, Mr. Dow recalled that in several of the earliest discussions before the Society, notably those relating to "Glare" and "The Measurement of Light and Illumination," various problems had been raised, and had been receiving attention ever since. A list of possible researches presented by a committee early in the war also showed "intelligent anticipation." Several of the questions then dealt with, such as the need for a standard of "white light." the specification of heat-resisting glassware, and the standardisation of dimensions of lamps and burners, had since proved to be of great importance, and were now even more urgent than in the past. Many problems raised at meetings of the Society had been dealt with by means of joint committees, and the recently-formed Committee on Illumination under the Department of Scientific and Industrial Research was a valuable medium for attacking lighting problems of all kinds.

Researches had to be considered in terms of urgency. Some had immediate importance, others (such as the choice of a suitable primary standard of light) were of great scientific importance, but industrially not very pressing. Others again, such as experiments on the effect of light on the eye and the human body, were of fundamental importance, but obviously would not be quickly solved. It might be possible to classify research from the standpoint "By whom is the research to be undertaken?" There were, first, researches that were primarily scientific, such as investigations on light-standards and photometry, and those were best undertaken by colleges and such institutions as the N.P.L. Secondly, there were purely technical experiments, such as researches on lamps and lighting appliances, best done in the laboratories of manufacturing firms. Thirdly, there were problems involved in the application of light, in which both the lighting expert and the user should co-operate. Generally speaking, the last type of research was most conveniently tackled by a joint committee on which all interests concerned were represented.

Mr. Dow then reviewed specific problems, stating that the problem of comparing lights that differed radically in colour was now understood to be, strictly speaking, insoluble, owing to the physiological peculiarities of the eye. The integrating sphere and kindred appliances were now regarded as of great practical value in view of the recognition that sources could not be satisfactorily compared in terms of candlepower in one direction. In this connection Mr. Dow described several devices adopted recently on the Continent. Illumination photometers had proved a great aid to advances in methods of lighting, and had been much improved. But the battery was still a source of trouble; possibly the nickel-iron types, used in conjunction with a rheostat and voltmeter, might prove useful. Much work had been done on photoelectric cells, which already constituted a valuable laboratory device and might ultimately be applied to produce a direct reading illumination photometer. Photometry had also led to entirely new methods in the planning of access of daylight into buildings, based on the "daylight factor."

As regards advances in illuminants, recent years had formed a period of steady development rather than radical departure. But there was room for great progress—possibly by means of the luminescence of gases. Theoretically, a source which yielded white light and no other radiation should give about 25 c.p. per watt, whilst a source producing only the efficient yellow-green light might have an efficiency of 50-60 c.p. per watt. Luminescence should also enable the colour of sources to be controlled. Hence the applications of coloured light, for spectacular and decorative effect, and their influence on the mind and body deserved attention. Invisible light, *e.g.*, ultra-violet rays, also deserved study.

Mr. Dow then emphasised the need for evidence on the physiological side with regard to the effects of glare and the intensity of illumination requisite for various purposes. Reference was made to the need for statistical information, such as the use of light for street lighting per head of population in various cities, the proportion of accidents in streets and factories due to inadequate lighting, and the advantages to be secured from better lighting in relation to output and quality of work.

In conclusion, various methods of encouraging research work were considered. It was remarked that in order to expedite progress, the Society should possess a research fund.

The ensuing discussion was opened by Lt.-Col. KENELM EDGCUMBE, who endorsed the wish expressed by the lecturer that this country should take a prominent part in the international development of research. Mr. W. R. Rawlings, Mr. P. J. Waldram, and Mr. A. Blok discussed various forms of research, pointing out that some required joint effort such as the Society could promote, and Mr. A. Cunnington referred to some experiences in the design of new lighting units for railway work. Mr. Leon Gaster mentioned some of the problems which it was hoped would receive attention from the committee working under the Department of Scientific and Industrial Research, all of which illustrated the need for joint effort.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

18,142. "Electromagnetic vibrators, telephones, or the like." Signal Ges. July 1st, 1922. (Addition to 184,154.) (209,118.)

21,830. "Means for obtaining a graphic record of electric currents." Marconi's Wireless Telegraph Co., Ltd. December 6th, 1921. (190,113.)

22,322. "Electromagnetic devices." Western Electric Co., Ltd. August 16th, 1921. (Addition to 188,088.) (184,894.)

23,747. "Electrical switchboards and circuit selecting apparatus." C. F. Atkinson. September 1st, 1922. (209,133.)

23,941. "Method of signalling over telephone conductors fitted with intensifiers with a signal current of high periodicity." Siemens & Halske Akt. Ges. September 5th, 1921. (185,428.)

24,388. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. November 22nd, 1921. (Patent of addition not granted.) (189,422.)

26,547. "Electrical lock and indicator." W. C. Dwyer and E. J. D. Dwyer. October 2nd, 1922. (209,154.)

26,695. "Electrical switches of the type technically known as "Ironclad." A. Willmott. October 3rd, 1922. (209,167.)

26,707. "Variable electric condensers." M. V. Pirie. October 3rd, 1922. (209,168.)

26,719. "Telephone and like headpieces." R. F. Tunmer. October 3rd, 1922. (209,170.)

26,744. "Microphonic transmitters." E. A. Graham. October 3rd, 1922. (209,173.)

26,745. "Combined gramophone and telephonic apparatus, applicable for use with wireless telephonic transmitting and receiving apparatus." E. A. Graham. October 3rd, 1922. (209,174.)

26,818. "Electric welding apparatus." A. E. Cutler and P. A. Marsden. October 4th, 1922. (209,180.)

26,819. "Electric welding apparatus." A. E. Cutler and P. A. Marsden. October 4th, 1922. (209,181.)

26,839. "Dynamo-electric machines." G. M. Pestarini and Metropolitan-Vickers Electrical Co., Ltd. October 4th, 1922. (209,183.)

26,842. "Thermionic valve circuits." P. W. Willans. October 4th, 1922. (209,184.)

27,094. "Distributors for magneto-electric machines." British Thomson-Houston Co., Ltd., A. P. Young, and H. W. H. Warren. October 6th, 1922. (Patent of addition not granted.) (209,197.)

27,201. "Illumination of rooms and the like by external sources of light." British Thomson-Houston Co., Ltd., and H. C. Wheat. October 7th, 1922. (209,201.)

27,668. "Sparking plugs." M. S. Mason and Smithbrook Engineering Co., Ltd. October 12th, 1922. (209,207.)

27,868. "Systems of generation of alternating current." E. Y. Robinson. October 14th, 1922. (209,212.)

28,473. "Electric ignition apparatus for internal-combustion engines arranged at the same time for the supply of illuminating current." G. Unterberg. January 12th, 1922. (191,705.)

29,112. "Electric switches." British Thomson-Houston Co., Ltd., and L. Griffiths. October 25th, 1922. (209,227.)

30,364. "Petrol-electric propelled vehicles." W. L. Spence. November 7th, 1922. (209,239.)

30,469. "Valve amplifiers for electrical oscillations." Ges für Drahtlose Telegraphie. November 19th, 1921. (189,112.)

30,606. "Electric switches." J. H. Hewitt and Wilkins & Wright, Ltd. November 9th, 1922. (209,241.)

30,808. "Transmitters for electric recording and signalling systems." J. S. Wilson, A. B. Buckley, and W. Clark. November 10th, 1922. (Addition to 163,773.) (209,242.)

30,990. "Automatic electric motor-control systems." A. D. Ferguson and Metropolitan-Vickers Electrical Co., Ltd. November 13th, 1922. (209,243.)

31,007. "Adjustable mountings for electric lamps." E. W. Puckert. November 13th, 1922. (209,244.)

31,273. "Electric insulators." British Thomson-Houston Co., Ltd., and J. H. Butcher. November 16th, 1922. (209,245.)

32,206. "Galvanometers." Etablissements E. Belin and E. Belin. November 24th, 1922. (209,255.)

33,609. "Electric switches and operating mechanism therefor." British Thomson-Houston Co., Ltd. (General Electric Co.). December 8th, 1922. (209,268.)

33,937. "Galvanic batteries." Oldham & Son, Ltd., and W. D. Wilde. December 12th, 1922. (209,272.)

34,248. "Asynchronous induction machines with compensation of the phase displacement." Dr. T. Torda. September 20th, 1922. (Patent of addition not granted.) (204,294.)

34,938. "Electric heater elements for electric radiators." G. H. Ide and M. J. Railing. December 22nd, 1922. (209,283.)

35,180. "Starters for electric motors." Igranic Electric Co., Ltd., and G. H. Pickering. December 27th, 1922. (209,287.)

35,436. "Electric switches." British Thomson-Houston Co., Ltd. April 10th, 1922. (Addition to 176,740.) (195,936.)

1923.

184. "Jointing of metal-sheathed electric cables." W. T. Henley's Telegraph Works Co., Ltd., and P. Dunsheath. January 2nd, 1923. (209,292.)

1,592. "Sparking plugs." T. E. Davies, P. A. Davies, and F. Rowland. January 18th, 1923. (209,298.)

1,700. "Accumulator or battery boxes." H. H. Seddon. January 19th, 1923. (209,299.)

2,623. "Terminals for electrical conductors." M-L Magneto Syndicate, Ltd., and A. P. McGowran. January 29th, 1923. (209,306.)

2,631. "Electrical measuring instruments." J. W. Record. January 30th, 1923. (209,307.)

5,450 "Electrical condensers." Muirhead & Co., Ltd., and H. J. Marshall. February 24th, 1923. (209,325.)

7,467. "Device for retaining trolleys or collectors for electricity on their wires or rails." F. Lennan. March 15th, 1923. (209,334.)

8,081. "Electric incandescent lamps." P. van Bommel. March 21st, 1923. (209,338.)

8,286. "Storage battery (electric) or accumulator." T. C. Cameron. March 23rd, 1923. (209,341.)

8,996. "Transformers for audio-frequency amplifiers and the like." Western Electric Co., Ltd., C. P. Smith, and W. L. McPherson. March 29th, 1923. (209,345.)

9,690. "Telephone receivers." R. C. Browne. September 9th, 1922. (203,652.)

13,526. "Form of electric condensers." C. E. Vawter. May 23rd, 1922. (198,355.)

15,226. "System of, and apparatus for radio communication." J. H. Hammond, Junr. August 11th, 1922. (202,278.)

17,718. "Electrolytic electricity meters." Schott & Gen. August 7th, 1922. (201,892.)

18,359. "Electrodes for electrolytic cells." Electro Chemical Co. July 15th, 1922. (200,838.)

21,937. "System of electrical connections for rectifier plants having rectifier cylinders working in parallel." Akt. Ges. Brown, Boveri et Cie. September 1st, 1922. (203,339.)

22,472. "Process and apparatus for the automatic operation of the air-exhausting apparatus in mercury-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. September 9th, 1922. (203,702.)